ENGINEERING NEWS

THE Wanamaker elevated railway project in Philadelphia seems to have had the effect of awakening the promoters of underground transit in that city to a lively sense of the necessity for doing something. The elevated scheme has certainly run against some unexpected snags in the shape of vigorous local opposition and the fact that they can not build on the chief north and south routes selected, because the surface roads now there have exclusive privileges derived from the State. So the underground men, in the shape of the Metropolitan Company, see their chance, and claim that financial arrangements are progressing most favorably, and that their plans are so far completed, that they can very shortly present them to the proper city authorities for approval. They already have powers granted them by City Councils, in March last, on condition that their plans be approved by the Board of Highway Supervisors, and that they file a bond of $10,000. They estimate the entire cost at $1,000,000 per mile, and are required to complete it on the specified routes in 7 years. While we do not recommend underground transit as a rule, when compared with traveling in the sunlight, the straight, wide streets of Philadelphia, and its general topography and soil are peculiarly favorable to such an enterprise. And the further—not peculiar—opposition of the great proportion of Philadelphia house-holders to any interference with their property rights will make an elevated road very problematical. It does make a difference, when nearly every man owns the house he lives in, as to whether an elevated structure should or should not be planted before his door.

THE Michigan House of Representatives has passed a bill fixing rates of railroad fare at two and one half cents per mile with 500 mile tickets at $10, and the privilege to newly constructed lines or branches of charging three cents per mile for six years after completion. The bill now before the New Hampshire legislature for uniting the railroads of that State under one corporation, fixes rates of fare at two and one-half cents per mile on lines south of Concord and three cents on roads north of that point. Dividends are also limited—probably a needless precaution—to ten per cent.

ANOTHER great railway manager, Mr. A. A. TALMAGE, has broken down under mental strain at the early age of 63, and permanently retired from those duties which, like so many other men, he probably found it impossible to abandon or to lighten until death stepped in and compelled him to. His death, like that of Mr. HOXIE a few months since, is ascribed primarily to overwork and over-anxiety in last year's great strike. There is something very remarkable in the way in which one of these great managers after another breaks down in this way, from the same cause, and almost at the same age. The warning is one which might well be given more heed.

OFFICIAL hankering after notoriety has led to a very silly order in Council in Canada declaring that "unauthorized and inappropriate names" have been given to natural features in the Northwest, and it changes the names of five of the Rocky Mountain peaks as follows: Boundary Peak to Pope's Peak, after the Minister of Railways; Mount Hermit to Mount Tupper, after the Minister of Finance; Mount Carroll to Mount Macdonald, after the Premier; Mount Cunningham to Mount Mackenzie, after the ex-Premier, and an unnamed mountain to be called Mount MacPherson. The old names are almost every one of them better than the new, and the chances are that they will stick, and ought to.

THE Railroad Commissioners of Massachusetts have sent circulars to the presidents of all railroads in the State asking them to send in for all railroad bridges complete plans of structures with dimensions, stress diagrams, date of erection, name of designer and a mass of general information in tabular form. This is good work as far as it goes, but it yet remains to be seen whether the recommendations of the Commisson will be better heeded in the future than in the past. They want more power.

Mr. J. F. O'ROURKE, chief engineer for the Union Bridge Co., in the erection of the Poughkeepsie bridge, referred at greater length, in his description of the bridge at the Kaaterskill Convention of the American Society of Civil Engineers, to the "long-pile splice" illustrated in our issue of June 25. Mr. O'ROURKE says that 528 of these piles are used to support each of the 500 ft. connecting spans and the maximum load on each pile will be 5 tons. They were driven with a 6,500 lb. hammer. They had occasion to draw several of these piles which depend solely upon friction for their sustaining power. To draw them they had first to break the mud contact by driving them; the first two or three blows would not move them, but about the fourth blow they would sink about one foot when they could be pulled up. In handling them they had to be slung horizontally supported at the center, and this was done without any failure at the splice, that being practically the strongest part of the pile.

THE Chinese are reported as actually building a railroad from the mouth of the Pei-Ho river to the interior by way of Tien-Tsin. French capital to the amount of $4,500,000 is being used, all efforts of the Viceroy to induce native capitalists to invest being as yet in vain. At present China has but 7 miles of railroad actually in operation; the one leading from the Kai-ping coal mines; but this is to be extended to a distance of 22 miles. An encouraging sign of progress, however, is seen in the gradual interest shown by leading men in the Empire in railroad matters. The advances of Russia from the West and England from the South are having much to do with this.

THE Birmingham (England) compressed air project is so far advanced that in about two months power to the amount of 6,000-H. P. can be supplied. There will be 15 separate engine houses, each containing 3 Lane patent water-tube boilers and 1 triple expansion beam engine of 1,000 indicated-horse power, driving 6 single acting air-compressing cylinders coupled to the opposite end of the beam capable of delivering together 2,000 cu. ft. of air per minute at 45 lbs. per sq. in. above atmospheric pressure. The mains vary in diameter from 7 to 24 in. and are 18 miles in length. These are laid in concrete troughs with removable covers and FORSTER'S patent joint to allow for the expansion and contraction. The air will be supplied to consumers through a meter somewhat like a Beale gas exhauster.

Engineering says that the London Hydraulic Power Company is steadily extending its service. Commencing in March, 1884, with power supplied to 54 machines, the company in March, 1887, operated 458 machines. Twenty miles of mains are laid and constantly charged with water under 700 lbs. pressure to the square inch with a constant day and night service. It is applied to engines for pumps, elevators, hydraulic presses, etc.

THE Russians propose to connect the rivers Don and Volga by a canal about 35 miles long, the purpose being to give the immense traffic of the Volga an outlet to the Black Sea. The estimated cost is about $14,000,000. The deepest cutting will be 140 ft. through sandy soil, and the canal dimensions will suffice to take vessels 210 ft. long, 42 ft. broad and 7 ft. deep. The canal commences on the Volga, at a point 7 ft. lower than the Black Sea and terminates on the Don at a point 119 higher than the sea.

THE first experiment of lighting the Hoosac tunnel by the electric light has been so successful that the Westinghouse Electric Light Co., is about to illuminate a half-mile section in a similar manner with the intent of finally lighting up the whole tunnel. Incandescent lamps are used, suspended from horizontal iron bars in the side of the tunnel. The feed-wire is carried in at the eastern portal, and along the ends of the ties, so as to avoid the damp sides of the tunnel.

THE Mexican National is arranging for the immediate construction of the gap of 304 miles, mostly of light work which now exists in its main line between San Miguel and Saltillo. Funds for the work are already in hand. We believe it is intended, most unwisely we think, to build the new track like the old one, of narrow-gauge, with the certainty that it will have to be changed to broad-gauge within a few years to compete with the Mexican Central on equal terms. The late sale of the road, which has resulted in securing the money for this work, was not, it appears in the Louisville & Nashville interest, as was generally supposed and stated.

THE most serious railroad accident of the week occurred July 2 near St. Thomas, Ont., and was caused by the breaking of an axle. The accident occurred to a freight train on the London & Port Stanley division of the Grand Trunk Railway; the axle was on the fifth car from the engine. The track was displaced for a considerable distance and 14 cars were wrecked. Two men were killed.

DURING the week washouts have occurred on the Southern Pacific Railroad in Arizona, the Atchison, Topeka & Santa Fé Railroad in New Mexico, and on the Bangor & Portland and Martins Creek railroads in Pennsylvania, all caused by storms. Several county bridges in Pennsylvania are injured and much damage has been caused. A waterspout occurred in Arizona July 2. A severe drought is continuing in Illinois and Wisconsin. An earthquake shock was felt in New Hampshire and Vermont, June 30.

IN changing the gauge of the Toledo, St. Louis & Kansas City R. R. last week the prize offered for fastest work was won by Owen McSweeney; with 30 men he changed 5 miles and 84 ft, between "5 A. M. and 12: 10 P. M.," or in 7 hrs. 10 min. if the report is correct.

Mr. CHAS. A. ASHBURNER, late of the Penna. Geological Survey, has collected for the U. S. Geological Survey the statistics for the coal production of 1886. In the last year the total production, exclusive of that used at mines, was 107,682,209 short tons, valued at $147,112,755 at the mines. Of this 36,696,475 short tons were Pennsylvania anthracite, valued at $71,558,126. The remainder of the output was bituminous, brown coal, lignite and small lots of anthracite from Arkansas and Colorado. The colliery consumption varied from nothing to 8 per cent. of product. Including this consumption the total absolute coal output in the United States for 1886 was 112,743,403 short tons. Compared with 1885 the anthracite output was 699,473 tons greater but sold for $552,828 less money. The bituminous output was 1,086,408 tons more, but its value was $3,366,592 less. The total net gain on 1885 in output was thus 1,785,881 short tons, but the loss in spot value was $4,419,420. Pennsylvania alone produced 62,857,210 short tons, or about one-half, of the total output.

M. LIPPMANN has recently proposed to the French Academy of Sciences the introduction of a new unit of time to replace the arbitrary and variable second. He suggests a unit based upon some ascertained electrical resistance which can be shown to represent an interval of time, such as the resistance of a cube of mercury.

TORONTO, Canada, is discussing the adoption of brick street pavement as a substitute for cedar block. The sample of brick submitted is grayish in color and is 6 in. long by 4 in. wide by 6 in. deep. It is heavy and very hard and is made in England from furnace slag. It would cost about 50 cts. per sq. yd. more than cedar block pavement. Objection is made to it that it would be slippery and cost much more than the estimate given.

AN interesting illustration of the effect of heat upon cement paving may be observed on 40th street in front of the Gospel Tabernacle at the corner of 40th street and Madison avenue. The pavement was made in place in squares 4 ft. 9ins. by 4 ft. 11 ins. On June 28 it was noticed that two of these squares had expanded so that at the joint they stood full 2 ins. above the level of the adjacent pavement. The passing of persons over the "arch" finally cracked both pieces across the middle, not a continuous crack, allowing them to settle. The pavement is about 1¼ ins. thick.

Hoisting Machinery Used in the Erection of the Tower of the New Public Buildings in Philadelphia, Pa.

(General view shown in last issue.)

As might be supposed the erection of a tower which is ultimately to attain a height of 535 ft. above the street surface, calls for some specially devised machinery and appliances for the hoisting of the building material. We therefore illustrate and describe this apparatus as designed by WILSON Bros. & Co., engineers, of Philadelphia, in connection with the general view given in our last issue.

As shown in our illustrations the general arrangement of the hoisting crane is that of a pair of parallel trussed timbers carrying a traveling carriage and firmly braced together and supported on balancing trucks running on a circular track. This track rests upon a suitable frame-work which is supported on the successive floors of the tower as they are put in. The weight of the load, block and fall, etc., at the end of the jib is counterbalanced by the weight of the engine, boiler and machinery over the circular track.

The two main hoisting drums are arranged to work with a worm, instead of the usual cogged gearing, with a view to safety in operating, and the clutches may be released without the engagement of a pawl in the teeth of a wheel. The drums for the ropes moving the load along the gib are also arranged with worm-movement for a similar reason. The worm is made of a soft steel casting and the worm wheel is made of strong, tough cast-iron.

The load lifted is about 14 tons, including the weight of the blocks and the maximum length of fall. The projecting boom is built of two 12 x 15 in. timbers trussed with rods as shown, running over the two masts resting upon two of the trucks running upon the circular track. This boom carries at its extremity a pair of sheaves over which the hoisting rope is lead from the under side of the main drums and thence over a pair of sheaves on the traveling carriage, then down to the two sheaves of the falling block, up again over two other sheaves of the traveling carriage and thence back around a sheave placed near the forward trucks. This arrangement makes one continuous rope, the two ends of which are attached to the two separate main drums. By running these drums one at a time a slow speed may be obtained, raising the load at one-quarter the velocity of the circumference of the drum; or by running the two drums together in the same direction, the lifting may be done at one-half the circumference velocity.

The drums are 6 ft. in diameter and each one contains forty turns of a ⅝-in. steel wire rope. They are driven by worms on a horizontal shaft through worm-wheels attached to the outer ends of the drums. These worm-shafts each carry a pair of beveled pinions gearing with beveled wheels on the shaft leading to the engine, and these latter may be thrown in or out of gear by means of Frisbie clutches so as to turn the worm-shaft in either direction at will while the engine is running continuously in one direction. The engine is also connected with another worm-wheel and drum on which is wound up a rope attached to the traveling carriage and carried over a sheave at the outer end of the boom; this appliance serves to run the carriage in and out on the boom, the main hoisting rope running idly meanwhile over the four carriage sheaves.

The engine is also connected with a vertical shaft directly over the center of the circular track, and by means of bevel gearing and radial shafts (see cut) the wheels of the supporting trucks are made to travel on the track resting on the trestle-work, swinging the boom in a circle. All of this machinery is carried on a heavy cast-iron frame, well secured over the trucks under the rear end of the boom. An upright engine secured to this frame, and supplied by steam from a vertical boiler furnishes the power, a small house encloses all the machinery.

The trestle-work upon which the hoisting apparatus rests, consists of 8 main posts placed close to the interior corners of the octagonal well of the tower. These posts are connected together at their tops by four strong Howe trusses spanning across the tower, and also eight smaller trusses around the circumference. At the intersection of the four main trusses mentioned, are four other vertical posts connected with the eight outside posts by Howe truss bracing, forming four independent triangular towers connected together at the top by trussing. When the machine is in use these four piers are temporarily braced together with Howe truss bracing, and the feet of the posts rest upon blocking supported on the wrought-iron cross-girders which occur at intervals of from 15 to 30 ft. in the height of the tower, and are intended to support floors in the completed structure.

When the tower has been built up to the height of one story above the bottom of the trestle-work, two of the iron girders intended for floor supports are put into place between the trestle posts, and the wall then carried up very nearly to the level of the under side of the hoisting boom. On the two girders mentioned are then placed small cross girders carrying four nests of anti-friction rollers, and above these four nuts through which pass long screws extending down to the foot of the timber framework and secured to it. When it is desired to raise the trestle the temporary bracing is removed between the four towers, and the nuts are turned by ratchet wrenches and the whole trestle raised to the height of one story. Blocking is then placed under the feet of the posts and the bracing replaced between the towers, leaving the apparatus in position to build another section of the tower. This same operation is repeated at every floor.

The Gogebic Iron Mines.

The Hartford *Evening Post* lately gave a very full account of these wonderful Michigan and Wisconsin iron deposits and from it we make the following brief abstract:

The Gogebic Range is a belt of mountainous and heavily timbered country situated near the extreme northern boundary of Michigan and Wisconsin. The iron territory lies in a strip about 40 miles long and with an average width of about one-quarter mile and is nearly equally bisected by the Montreal river, which forms the boundary between the two States. The original discoverer of the deposit was Mr. N. D. MOORE, a practical mining expert, who found it in 1874, and was fortunate enough to secure for himself enough of what was then government land to make him now one of the largest holders of stock in this mineral treasure.

The ore does not lie in veins but in "lenses," or detached masses, resting upon an unbroken base of granite. These deposits vary in mass and depth, but in a shaft 300 ft. deep no terminal point in the ore "lense" has yet been found. About twenty companies are now developing this property and extracting ore in immense qualities some of them shipping 1200 tons per day. In one of these mines galleries and cross-cuts have been run for 4000 ft. through a solid mass of ore although actual work upon these mines scarcely dates back of 1885. Hurley, a town of 5000 inhabitants, has sprung up since the mining began and other towns are being started.

The iron is a soft hematite ore of a dark reddish brown color, the "Bessemer hematite" and is very easily mined. The ore is carried by railway to Hurley and then taken 40 miles to Ashland the shipping point on Lake Michigan. At this latter point are three ore docks each over half-mile in length, wide enough for four tracks and rising about 40 ft. above the water. Two of these docks belong to the Milwaukee & Lake Shore R. R. Co., and one is owned by the Wisconsin Central R. R. Co. The storage capacity of the pockets in the first named docks is 90,000 tons and they are so built that 125 tons of ore can be transferred from the cars to vessels in five minutes. The three docks are very substantial and cost over $1,000,000.

In 1886 the total output was somewhat less than 800,000 tons, this year it will reach about 1,500,000 tons, and it said that twice this latter amount could be sold were it ready for delivery and the necessary transportation at hand. The cost of putting down a ton of this ore at Cleveland, Ohio, is given as follows:—

Mining and loading on cars	$ .75
Rail to shipping port	.70
Vessel to Cleveland	1 90
Commission and Insurance	.15
Royalty	.50
Total cost per ton	$4.00

The selling price at present in Cleveland is $6.00 per ton, showing a very handsome profit for the mine owners.

Report of Sub-Committee on Electrical Appliances, Burlington Brake Tests.

The following is the report of a sub-committee composed of Mr. A. H. BOWMAN, electrician, Lehigh Valley Railroad; Mr. E. M. HERR, acting superintendent of telegraph, Chicago, Burlington & Quincy Railroad; Mr. O. E. STEWART, formerly superintendent of telegraph Chicago, Burlington & Quincy Railroad, now superintendent of the East Iowa Division of the Chicago, Burlington & Quincy.

BURLINGTON, IOWA, May 25, 1886.

Mr. Godfrey W. Rhodes, Chairman Master Car Builders' Brake Committee.

DEAR SIR:—In pursuance with the committee's instructions in letter of May 19th, we have made an investigation of the electrical appliances used by the Eames, Carpenter, Westinghouse and Card brake companies in the 1887 brake test, and respectfully submit the following report:

As to the use made of electricity, we find the brakes represented naturally divide themselves into two classes, one in which electricity is entirely depended upon for the proper operation of the braking mechanism, the other in which it is used as an auxiliary or addition to braking device complete in itself.

In the first class are found the Carpenter electro air-brake and the Card electric brake.

In the second the Westinghouse automatic air-brake and the Eames automatic vacuum brake.

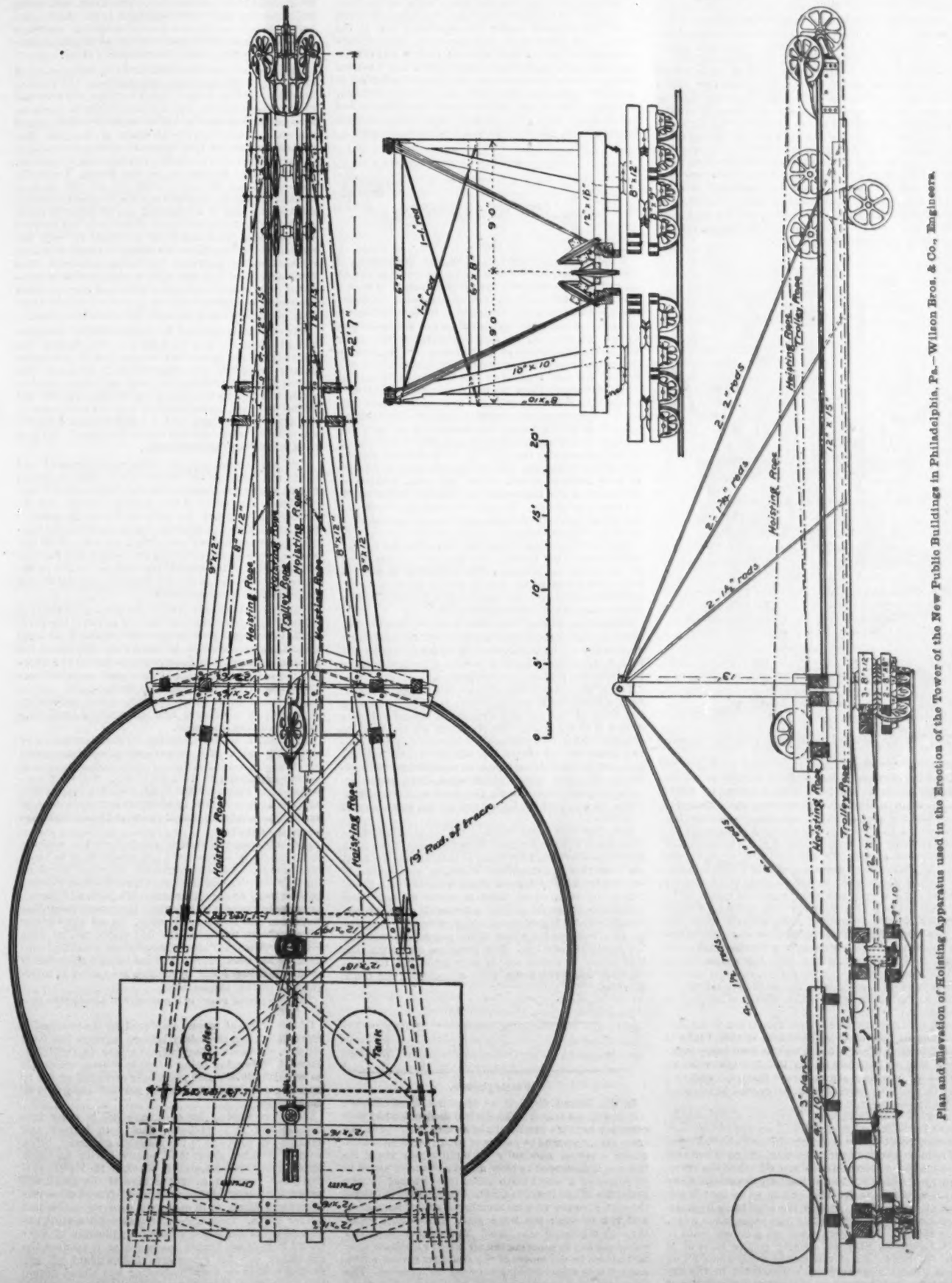
All the above are arranged on the open circuit system, with the exception of the Card, in which the circuit is closed, but the two batteries, one on the engine and one in the rear car, are so opposed to each other that in the normal condition no current passes through the train. In the open circuit system it is to be understood that unless the brakes are either being applied or released, no current is passing or being supplied by the batteries or other electro generating devises. This is also practically true in the closed circuit system employed by the Card Brake Company.

Taking up in order the four brakes examined, we have, first, the Carpenter electro air-brake. The electrical appliances used by this brake company consists of a secondary "Julien" battery of eight cells, carried in a box upon the left-hand side of the engine, securely fastened to the frame and guide yoke, and two systems of electro magnets connected in multiple are upon the three-wire systems, one set of magnets operating the admission, the other the release valves. They also exhibited a magneto machine, by means of which the brakes could be operated by the engineer independently of the battery. This machine was not properly adjusted for the work to be done on these tests, and was therefore not used. The brake and release-valves referred to above are shown in section on drawing No. 892 of the Carpenter catalogue, in which a full description of the brake mechanism is given. [See engravings and description in *Railway Review* of May 21, '87]. The following diagram roughly illustrates the manner in which the electric apparatus mentioned above is connected in this brake system.

Carpenter.

In this diagram *B* represents the battery: *H* the handle of the engineer's valve which closes the circuit *A X* by being moved into contact with point *A* or *B Z* by being moved in contact with point *B*. In the first case the current would be caused to flow through the magnets *M M M*, etc., returning by the common return wire *C Y* operating the admission valves and supplying the brake. In the second case the flow would be through magnets *M M M*, etc., returning over the same wire *C Y*, and operating in like manner the release valves. The connections between the wires on different cars are made automatically in coupling the brake hose by means of contact pieces in the hose coupling as shown on drawings No. 901 of the Carpenter catalogue. (See *Railway Review*, May 21). These pieces are held in firm contact by a powerful spring, and are well rubbed, in coupling, making a clean, firm contact. The wires are run under the bottom of the cars and through the hose to the couplings.

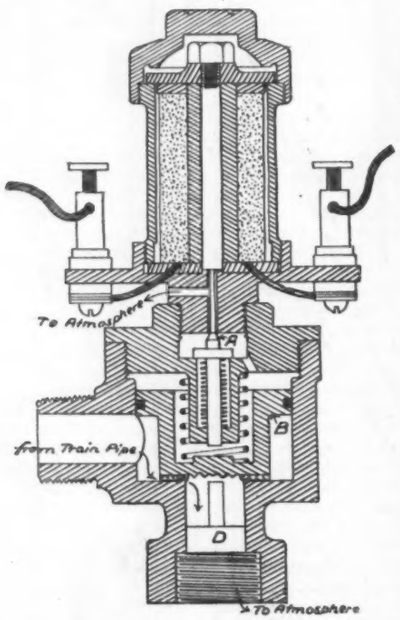
The resistence of each electro-magnet was found to be 200 ohms, making for a 50-car train, when connected as shown, a total resistance of four ohms. It is worthy of note that with a battery of constant electric motive force, the resistance being increased inversely as the number of cars in the train, a constant current strength is maintained through each magnet regardless of the



Plan and Elevation of Hoisting Apparatus used in the Erection of the Tower of the New Public Buildings in Philadelphia, Pa.—Wilson Bros. & Co., Engineers.

number of cars, making no adjustment necessary for different lengths of trains.

With this arrangement of battery and resistance considerable current is used while the circuit is closed, but as this only takes place while the pressure is either being increased or decreased in the brake cylinder, it amounts to but a small consumption of battery even for a number of stops. Calculations show that with a 50-car train the braking force could be increased or decreased continuously for about 17 hours before the strength of the battery would be destroyed, and a proportionately longer period for a shorter train. From the way in which the circuit is run it is easily seen that should an accident happen to any of the wires, causing their rupture at any point, the brakes between such point and the engine would be unaffected thereby, while those on the other section would, of course, be inoperative. This feature would enable the brakes on the forward section to be released by the engineer in case of an accidental break in two.



The Westinghouse Electric Application Valve.

We found the conducting wires used fairly well insulated throughout their length, except at points where connection was made between wires to valves and the main conductors. No attempt at insulating of these joints is made. Perfect insulation is of great importance in this system, for should a cross occur between the two conductors, instead of the brakes being applied when an attempt was made to do so, the release, as well as the admission valves, would be open, and should the current be maintained, the auxiliary reservoir train pipe and main reservoir would all be completely bled. Should either wire come in contact with any metallic connection either with the train pipe or any of the braking apparatus, or any part of the car forming metallic connection with the track, the result would be that either the admission valves would cease to operate by electricity, and the brakes could not be set thereby, or being set they could not be released, depending upon which wire was touched or grounded.

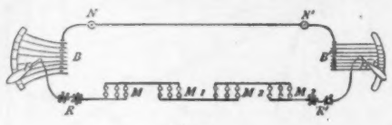
Rain, sleet or snow would work very much to the disadvantage of the electric appliances of this brake if the conducting wires are not well or completely insulated. It is perhaps fair to say that this brake can be applied by allowing air to escape from the engine's valve in case the current fails, but cannot be released except by electricity.

In regard to the details we found the electric appliances admirably designed and well worked out, giving, in our opinion, under ordinary circumstances, a good and reliable arrangement. The magnet and armatures are enclosed in the cast-iron cap on top of the valve, but are not within the compressed air chamber. They are separated from the rest of the valve by a heavy brass plate serving to protect the armatures from the magnetic influence of the other iron parts of the valve.

The amount of current used on a 50 car train is about 3 amperes with an electric motive force of 16 volts, the resistance of the circuit being about 5½ or 6 ohms. Fusible safety plugs are inserted in the circuit next to the battery to prevent the possibility of the magnets being burned.

The next in order is the Card Electric Brake.

This company uses two secondary batteries of a form devised by the inventor, Mr. CARD, consisting of 15 cells each, one situated under the engineer's seat in the engine, the other on the rear car of the train so connected as to oppose each other in such a way that no current passes under normal conditions. Also a system of three electric magnets for each brake connected in multiple series, together with an automatic rheostat current indicator and arrangement for cutting in and out as many cells as is desired to give the required braking force, all as shown in the following diagram:



Card.

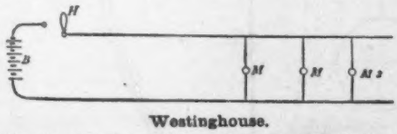
B and *B'* are the batteries, *M. M*2., etc., the systems of electro magnet, one for each brake connected as shown *R.* and *R'* the automatic rheostats arranged in such a way that should the train part at any point, the coupling for the wires are so arranged as to close the circuit on each section, thus cutting off part of the resistance before in circuits, an equal resistance would be automatically inserted at the rheostat. This maintains the current at a constant strength no matter how many or how few cars are broken off. The brake is applied while running, either by the conductor or engineer moving the handle *H.* or *H'* and thus cutting in or out, some of the cells, destroying the balance and causing the current to flow through the magnets *M. M'* etc., the amount of flow and consequent severity of application of the brakes being regulated by the number of section over which the handle *H.H'* is moved. The resistance of each magnet is low, being one ohm, making in resistance of the three used in each car, ½ ohm when connected as shown. The total resistance of each car including conducting wires, is ¾ ohm, or a total of 25 ohms for a 50 car train.

Although considerable current is required for the full application of the brakes, only part of it is necessary for a partial application. The current is passing in this system while the brakes are in operation, for, not only must the current pass to apply the brakes, but it must be maintained to keep them on.

Calculation shows that with a battery used of the capacity of 10 ampere hours, 10 hours of the maximum application of the brake could be obtained before the battery is exhausted and of course a proportionately longer period for gentler applications.

The conducting wires used by this brake company are not insulated excepting where they are fastened to the body of the car and consist of galvanized wire cables ¼ an in. thick. The couplings are arranged to complete the circuit through one wire by a sliding contact piece in the centre, the return current passing through the outside casings of the couplings. They are designed to pull apart at the couplings under all circumstances; for should the hose and connection wires be ruptured the brakes on neither section could be applied.

The effect of a cross between the conducting wires here would be to apply the brakes throughout the train and as no effort has been made to insulate the conducting wires this is an accident which, in our opinion, is extremely likely to happen either from the direct contact or by rain, snow, sleet or other causes. The automatic rheostat is also a delicate piece of mechanism liable to get out of order with the possible result of burning out some of the magnets, rendering the brake inoperative. The principal on which this this brake is gotten up is admirable, but the mechanism employed some what complicated for train services.



Westinghouse.

In the second division we have the Westinghouse Automatic air-brake. The electric device used by this company consists essentially of a valve inserted in the train pipe, operated by means of compressed air, which raises a piston nominally in equilibrium when its balance is destroyed by blowing off a chamber above it by means of a small valve raised from its seat by the armature of an electro magnet. The current is passed through a copper wire insulated with rubber insulation and run through the train pipe. The return being through the metal pipe itself. The wire is connected automatically in coupling the air hose by means of contact pieces in the centre of the coupling giving a firm contact with slight rubbing between the surfaces. The magnets used are wound to a resistance of 11 ohms each, and but three being used in these tests connected as shown in the diagram below in multiple, the total resistance about 3⅔ ohms for the magnets, and about two ohms for the conducting wire, is 5⅔ ohms. The battery used would suffice for a long time as the wires are so connected to the engineer's valve that no electricity would be used except for emergency stops.

The wires are carefully insulated and being enclosed in the train pipes are well protected from the weather Should a metallic contact occur between the wire and the pipe however, the result would simply be to render inoperative the electric valves which as before stated are entirely auxiliary to the brake mechanism. The electric features of this brake are well worked out and in our opinion give a reliable and practical apparatus.

The electric appliances to the Eames Automatic Vacuum brake are also auxiliary to the vacuum mechanism itself. It consists essentially of an electric magnet enclosed in a cast-iron cap or chamber which can be put in communication either with the vacuum or the main valve auxiliary re-servoir or with the atmosphere according as the circuit is made or broken as explained on page 24 of the Eames catalogue. (See *Railway Review* May 21). Also a metallic circuit composed of a single conducting wire and the magnets connected, as shown in red on the cut submitted herewith, the return being through the rails of the track.

The current is supplied by dynamo having an armature 9 in. long and 8 in. in diameter; this dynamo has no governor and is entirely beyond control and varies greatly in speed. The magnets as is seen, are connected in series, making the total resistance equal to the sum of the resistances of the conducting wire and all the magnets, necessitating a very low resistance in the latter 12 ohms each and a current of considerable strength to overcome the entire resistance, which is for a 50-car train, about 30 ohms.

The conducting wire is fairly well insulated and being run through the train pipe is well protected except where it is connected to the spiral wire through the hose. The effect of any metallic contact and the conducting wire and the parts of the car in metallic connection with the track would be as far as the electrical attachments are concerned, to cut out all the brakes between this point of such contact and the rear of the train. If the conducting wire be broken or detached, in any way causing a break in the circuit, the entire electric apparatus fails.

No effort was made to protect the armatures from the effect of the close proximity of iron in the other parts of the valve and in several ways the details of the electrical attachments might be improved. The use of the track as a return is to deprecated on account of interruption to current in case of insulated track-sections put in block signal systems, draw bridges, etc.

It seems to us the whole question of the application of electricity to railroad braking resolves itself into three important questions.

First, can a valve mechanism be made operative by electricity which shall be permanent and practicable for railroad service, not having parts too sensitive or of too fine adjustment? We think it can. The valve construction as shown by Mr. CARPENTER the same which he used in these trials, is certainly not more delicate and complicated that that of the well known Westinghouse triple valve.

Secondly, can the electric conductors for working these valves be so insolated and projected as to avoid short circuits and other injuries? We think it can by running the wires inside of the air pipes where they are as little liable to derangement and injury, and become as permanent and certain in their functions as any other feature of the brake mechanism. In all the electric brakes shown the wires are laid inside the air hose coupling where they are fully protected, and their connections are made from car to car easily and certainly so that this important point is so far settled as to require no further explanation.

The remaining point is the source of the electro motive force.

Of the different means employed by the companies represented, the secondary battery appears the most reliable, giving a constant current all the time until discharged, recharging being a simple process which can be so methodically and practically arranged as not to interfere with the brake service, nor add materially to the expense.

If brakes worked by electricity are to come into general use, it is probable that both battery and dynamo will give way to the magneto generator, being a small machine about 18 in. square, having an easily turned crank which instantly develops the electro motive force required, so that a turn of the crank will actually apply or release the brake. One of these machines was shown us in operation upon an engine and tender brake. This apparatus may solve a most important point connected with the application of electricity to railroad brakes inasmuch as it renders the apparatus on the locomotive independent of any special station or roundhouses, or any stated period when a battery, if used, would have to be recharged.

We believe from what we have seen at the Burlington

brake tests and from a close personal examination of the several electrical arrangements for braking, that electricity properly devised and managed may be made a valuable auxiliary to actuate power brakes on long trains, and their efficiency considerably increased thereby.

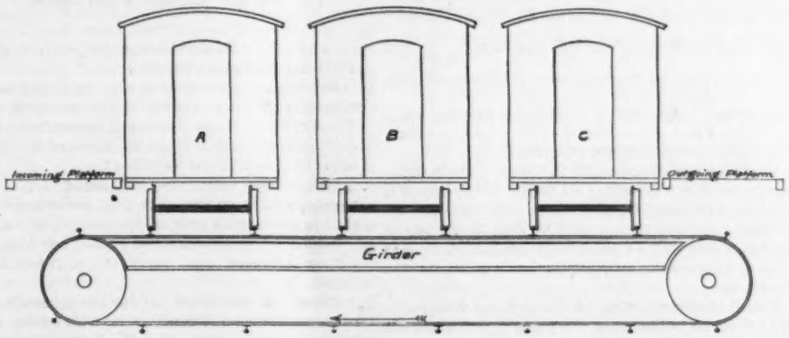
CORRESPONDENCE.

The Brooklyn Bridge Problem.

BROOKLYN, E. D. June 21, 1887.

EDITOR ENGINEERING NEWS:

Noticing your illustration of the proposed terminal facilities of the Brooklyn Bridge I would suggest the following plan, as shown in accompanying sketch which shows a train at *A* which has just come in, a train at *B* to be moved onto the outgoing track when the train *C* on the outgoing track has left the platform. The plan consists in moving the trains sidewise from *A* to *B* and from *B* to *C*. The track *B* is



Proposed Solution for the Brooklyn Bridge Problem.

added so that the distance moved may be as small as possible, and it may, if adviseable, be kept empty and have a switch to run a train on in case of necessity. The moving may be accomplished by the incoming and outgoing trains, at the time of coming in or going out, or by means of an accumulator at any time. The moving tracks need be but the length necessary to hold the car wheels on each end of the cars. Trains can be made up the whole length of platform at least six cars in length. Yours Truly,

E. J. WOOD.

[Theoretically, the outlines of this plan are all right, but the practical difficulties are of a serious nature, especially as much longer than six-car trains are needed to answer the requirements of the very near future, even if the present inconvenient crowding be supposed to continue. It would only be feasible in connection with very careful interlocking protection, including a protecting buffer behind incoming trains, and some movable and interlocked equivalent for joint connections between the fixed and moving rails. The insuperable objection appears to be the number of moving parts, failure in any one of which stops the whole machine. The necessity for the intermediate track B is not apparent.—ED. ENG. NEWS.]

Camber in Bridge Trusses.

NORTH SCITUATE, Mass., June 25, 1887.

EDITOR ENGINEERING NEWS:

Your issue of June 18, contains an able article by Prof. I. O. BAKER on "Deflection of a Truss" in which the effect of changes in the lengths of the web members, as well as of the chords is included, and attention is called to the fact that the web is usually neglected.

It is in providing proper camber that deflection most interests us and in that light that the writer would consider it.

While there are engineers, possibly many, who take the web into account there are others who do not, and our text books quite neglect it. One eminent author, after giving the theoretical camber required by changes in the lengths of the chords, suggests that *in practice* it should *be doubled*, presumably to cover incalculable and uncertain elements but really because only part of the theory had been included.

Changing the length of the web members on account of *strain* and changing the lengths of the diagonals on account of *changes made in the chord lengths* must not be confounded. The latter is necessitated by the common practice of confining the changes of length for camber to *one chord*. For example, in a panel of an iron bridge truss the top chord is compressed by stress about the same amount that the bottom chord is extended and the changes in lengths of the chords will not practically affect the length of the diagonal and therefore if camber is provided by shortening the bottom chord and lengthening the top chord the diagonal length will be that of the original or rectangular panel. If, however, all of the difference is put into *one* chord as commonly done the diagonal length must be changed to correspond.

The deflection due to the web is not only considerable but it does not conform to the arc of a circle as in the case of the chords. This will be apparent by considering an extreme case viz., all of the web members under maximum stress at the same time, a condition which is approached as the span is lengthened and the ratio of dead to live load increased. The form of the chord, from strained web alone, would then be two straight lines inclining up to the abutments from the middle of the truss. Under actual conditions it would be a curve similar to the hyperbola being very sharp near the middle of the truss and easing off to lines nearly straight.

The combined deflection due to web and chord would not therefore be a circle and the usual specification, that the camber shall conform to the arc of a circle, seems of questionable value.

Since the object of camber is to insure that the bottom chord shall come approximately to a straight line when the truss is sustaining its maximum load and as deflection is due to the changes of length of all parts of the truss through the elasticity of the material, the proper way to provide camber would seem to be to change the lengths of all members of the truss by the amounts they are strained plus half the play in the pin holes (when connected with pins). Thus in an iron bridge with top chord at 8,000 lbs. stress, bottom chord and diagonal ties at 10,000 lbs. and posts at an average of say 6,000 lbs., taking the modulus of elasticity at about 25,000,000 we would lengthen the top chord panels by $\frac{1}{3200}$ of their lengths, and the posts by $\frac{1}{4200}$, plus $\frac{1}{16}$-in. and shorten the bottom chord panels and diagonal ties by $\frac{1}{4167}$ of their lengths plus $\frac{1}{16}$-in.

GEO. H. PEGRAM.

Most Economic Length of Bridge Span.

PHILADELPHIA, Pa., June 27, 1887.

EDITOR ENGINEERING NEWS:

In your issue of June 18, 1887, speaking of "The Elevated Railways of the Future," occurs the following statement:

"It is mathematically demonstrable, that the cost of a long bridge is at or near its minimum when the cost of the piers and the cost of the spans are equal to each other."

The same statement has some times been made by others and it is receiving almost the authority of a law merely from the frequency of its assertion; but it is erroneous, all the same.

It is true that a mathematical demonstration in support of such a rule can be furnished to order by almost any one, including myself, but it will not prove anything beyond the pre-conceived notion. It is derived from the plain and general rule, that the more expensive the piers and foundation, the longer should be the spans.

In some well-designed long bridges, the incidental fact was experienced of nearly equal cost for sub and superstructure. This does not prove that for the same or for a less aggregate sum no other equally good structure is practicable, in which the respective proportion of cost are very unlike.

The latter fact is the case in the majority of long and economical bridge designs. Equal cost of sub and superstructure is no criterion of economical or good designing. As far as I am aware this rule is not followed by experts. It is an incidental feature entirely. The elements and conditions entering in a design for a long bridge are many, and admit of a great number of variations and solutions in the hands of experts for nearly the same given aggregate cost.

Take the proposed high elevated railway as an instance, with stone or brick piers erected in the middle of the block. These piers will have to be proportioned for stability primarily, for if proportioned for loads only, they would be so thin and chimney-like, as to sway perceptibly under trains. Therefore good piers have a large margin of safety under loads, and the same pier will support four tracks on a double-deck bridge as safely as two tracks on a single decker. Result—no increase of cost, or only a slight one, for substructure and nearly double cost for superstructure. If iron piers were substituted for stone, the disproportions would be still more pronounced. Where would the engineer be, who would follow a rule of equal proportions of cost?

On the general subject of high elevated railways in New York, *vs.* tunnels under the streets or houses, your position is strong and proper.

A four-track elevated railway of superior construction would probably cost per mile less than one-half of the cost of a four-track tunnel road, and it would be infinitely more convenient and attractive, as well as profitable. BRIDGE ENGINEER.

[The theorem to which our correspondent objects, was deduced by the late Prof. RANKINE in one of his books, and was not claimed to have more than a theoretical and approximate application even to the single case considered. A viaduct of indefinite length, in which moving a pier did not vary its cost, other than as the load to be supported might vary it. In ordinary structures no such conditions obtain, nor even under precisely those conditions, could it be expected to be very exact. Still, in the case mentioned by our correspondent, turning a single deck into a double deck, the pier would naturally be made somewhat heavier and the structure certainly not cost twice as much nor nearly that, so that the rough rule is not so far out as our correspondent implies.—ED. ENG. NEWS.

Street Grade Intersections.

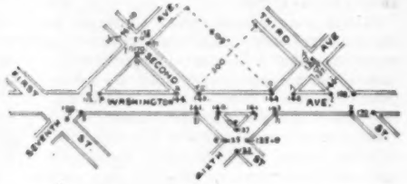
NEW YORK, June 1, 1887.

EDITOR ENGINEERING NEWS:

In answer to the problem suggested by your correspondent on page 186, March 19 last, I present the following solution, reference being had to the accompanying sketch.

It is impossible to make a satisfactory solution without knowing the elevation of the adjacent streets, and the contour of the ground within the limits of the streets given in the plot submitted. The grades on the sketch with a line below were given by your correspondent as established, all other grades have been arranged by the writer. The grades established at the intersection of Seventh avenue and Second street, with a rise of 5 ft. in 46 ft. is excessive. The greatest variation in the grades arranged by them at angles of intersecting streets is 3 ft., but in each case the intersection has been on a diagonal line, and the distance between grades about 80 ft.

The ratio of rise in the grades arranged for Washington avenue are 7.9 ft. per 100 ft. from a to b, and 10.19 per 100 from l to a. But if the grade 112 is used at p, the rise from p to a will be 11.42 per 100, and the rise from p to n will become 29.59 per 100. The difference in the grade between c and c is very light, not sufficient to prevent the storm-water flowing down Second street from crossing to the lower



side of Washington avenue. The curb between c and c can be depressed at a point about 100 ft. from 143c, sufficient to control it, and at the same time making the grade of the curb opposite harmonize, and giving a better cross-section for the pavement. The rise from d to f is also light, the difference being only one foot in 136 ft.; this will remove the storm-water, provided that the gutter is carefully paved. But for an unpaved street, it would be better to make a crown in the curb between d and f.

The ratios of grade from h to i is 14.73 per 100, and from h to r it is 10.35 per 100. At the intersection of Sixth avenue and Second street the writer has slightly modified the grade established by making the grade of the opposite curbs 2 ft. higher. But the grade 123 should be 124 or 125. The grades on Sixth avenue have a rise of 14.8 per 100 from e to f, and 13 ft. between e and h; from h to k there is a falling grade of 8.67 per 100, and from c to k one of 6.08 per 100. On Third street the rise in grade from k to i is 29.02 per 100, which is very precipitous. But as the grade has been established little modification could be made. The grades on Second street from e to d and c to b rise respectively 13.26 and 10.98 per 100; and from c to n and a to n the rising grades are 12.76 and 12.8 per 100. The rise in the grades of Seventh avenue from l to l is 26.6 per 100; but if the elevation 112 be fixed at p, the rise from p to n will become 29.59 per 100. Seventh avenue and Third street have gradients remarkably well adapted for coasting purposes, and in walking down them when covered with a coating of ice it would be a debateable question as to whether the nose or the toes would reach the bottom first.

The greatest inclination allowable in the cross-section of a side-hill street, would be kept by the writer within one foot and level if possible, he understanding your correspondent to mean the curb and not pavement elevation.

Yours truly, F. A. CALKINS.

The Deflection of Beams.

ST. LOUIS, MO., June 25, 1887.

EDITOR ENGINEERING NEWS:

In your issue of 18 inst., is a discussion of the deflection of a truss under a uniform load. The method there given has neither the merits of elegance, universal application, nor of accuracy to recommend it. The following well known method is in common use, but the writer has not met with it in any American treastise on the subject.

For any framed structure the deflection under any load may be expressed by the simple formula:

$$D = S\frac{a s l}{E} \quad (1) \text{ where}$$

D = deflection.
a = "member co-efficient."
s = stress per sq. in. in the member.
l = length of member.
E = modulus of elasticity.
S = sign of summation.

It will at once be apparent that $\frac{s l}{E}$ is the distortion (lengthening or shortening), of the member under consideration, and that a is a factor giving the *effect* of this distortion on the deflection. The sum of all these effects for all the members is the total deflection. The beauty and convenience of the formula lies in the elegant method of finding the value of a for all members.

In all cases the value of a is given by the following *Proposition: The numerical value of the "member co-efficient" is equal to the stress in that member, due to a unit load placed at the a point whose deflection is to be obtained.*

In other words *the load at the point is to the resulting stress in the member, as a distortion of the member is to the resulting deflection of the point.*

These propositions are susceptible of a general proof, but they will here be verified for a specific case only.

CANTILEVER.

Take a simple cantilever as a draw-bridge resting on its center pier, Fig. 1.*

We will discuss for the deflection at a, due to the the distortions in the three sides of the triangle $e f g$.

First, for the chord member $e g$. The center of motion for any change of length in this member is f, which is also the center of moments for finding the stress in $e g$. The deflection at a due to a shortening of $e g$ is evidently the amount of the distortion multiplied by the distance $a g$, and divided by the height of the truss $f g$. In other words the "member co-efficient" for this case is $a = \frac{a g}{f g}$. But for one pound load placed at a the stress on $e g$ is seen to be $\frac{a g}{f g}$ also, which verifies the proposition so far as chord members are concerned.

Second, the shortening of the vertical web member $f g$ results in lowering all points to the left of it by just this amount, and hence the "member co-efficient" for this case is unity. But the stress in this member due to one-pound load at a is also 1 lb., and hence the proposition holds good for the verticals.

Third, the lengthening of the inclined web member $e f$ results in lowering the point e, and hence all points to the left of e, by the amount of this distortion into the secant of the angle the member makes with the vertical, as is readily seen by drawing the figure. But the numerical value of the stress in the member $e f$ due to 1 lb. placed at a, is also unity into the secant of this angle, and hence the proposition holds for the inclined web members.

For cantilevers, then, we have the *Rule—To find the "member coefficient" for all the members in the system, put a one-pound load at the point whose deflection is to be found, and find (analytically or graphically) the resulting stresses in all members up to the point of support. The numerical values of these stresses will be the "member coefficients" for the several members.*

These coefficients are wholly independent of the actual manner of loading of the truss when computing a deflection, the same coefficients being used for any load or system of loads on that truss.

To compute the deflection of the end of a cantilever, therefore, find the values of s and l for each member of the truss for the given system of loads. Then $\frac{s l}{E}$ will be the *distortion* of that member, (whether tension or compression, it matters not,) and this multiplied into the "member coefficient" will be the deflection of the required point due to the distortion in this member. The sum of all these is the total deflection.

If E is the same for all members, it may be placed outside of the sign of summation, and we may then write

$$\Delta = \frac{1}{E} S a s l. \quad (2)$$

The value of E for iron and steel is about 27,000,000 while for timber it is about 1,600,000.

For simplicity of conception it may be worth while to put equations (1) and (2) in a still simpler form. Thus if d be the distortion (change in length, whether extension or compression) of any member, then we have

$$\Delta = S a d \quad (3)$$

where a is the "member coefficient" as derived above.

SPAN SUPPORTED AT BOTH ENDS.

In this case let us conceive of the middle as stationary and of the ends as lifted upward. To find the "member coefficient" put one pound at the end and *let it act upward*, and find the stresses in all the members on to the middle, which is now supposed to be fixed. In finding the values of the unit stresses s, however, we must, of course, take the actual stresses in the several members for the given loads considering the truss as supported at the ends, as it really is. The summation is then made from the center out to one end, for the deflection of the middle of the span for the loads taken.

This method of determining deflections is rigidly exact, readily proved, simple in conception, and very convenient in use. It would, therefore, seem to have every thing to recommend it. It has long been used by some of the leading bridge designers in this country, and is known to give very accurate results when a small additional allowance is made for the joints.

Yours truly,
J. B. JOHNSON.

*We are disappointed at the last moment in the cut for this diagram. It represents a four-panel cantilever with paral el chords and inclined end. The point of support is under the center post h. The three other posts are marked at top, commencing at the center, f, d, b. The bottoms of the four tension members are marked (from center) g, e, c and a. A load of one pound is suspended at a.

On the "Unsafe Floor-beam."

PHILADELPHIA, Pa., July 5, 1887.

EDITOR ENGINEERING NEWS:

Referring to an article in your issue of June 25th, signed J. E. BUDDINGTON, under the head of "An Unsafe Floor Beam," I would respectfully submit a short statement of facts in reference to the floor beam in question and its history.—

First.—The beam was calculated for a Mogul engine, which with an 18 ft. 9 in. panel length, gives a cross girder load of 68,400 lbs., not 77,600 lbs.

Second.—The actual dead load of one half of the girder stringers, ties, track, etc, is 11,800 lbs., not 14,400.

Third.—A duplicate of the beam, made of the same materials, had been tested with a total load of 270 tons, or 67½ tons at each of the four stringer points, giving an end shear of 270,000 lbs., without the slightest indication of giving way at any of the rivets or signs of buckling of the web, although the flanges were strained beyond the elastic limit. This test was made in the presence of a number of competent bridge engineers.

Fourth.—Supposing that an end shear of 111,400 lbs., were distributed over the 10 web rivets in the manner indicated by Mr. BUDDINGTON, so as to give stress of 11,975 lbs. per rivet, or 36,500 lbs. *per square inch of bearing*, would not an end shear of 270,000 lbs. give a stress of 29,000 lbs. per rivet, or 89,000 lbs. per sq. in of bearing surface? And is not this rather a heavy load for iron to stand without showing signs of failure? Again, since the calculated safe load according to Mr. BUDDINGTON is 36,630 lbs. per track and the girder has actually borne 270,000 lbs. per track, and without showing any signs of failure, is not a proof stress of 7 times the calculated safe load rather unusual? From the above facts it is self evident that Mr. BUDDINGTON'S assumptions as to the disposition of the strains in this girder are fallacious.

The writer of this article is responsible for the design of the girder in question, and has neither the leisure nor inclination to teach Mr. BUDDINGTON how to calculate the stresses in a girder with flanges not parallel, through the columns of a newspaper, or to argue with him.

In conclusion, Mr. BUDDINGTON was Engineer of the N. Y., N. H. & H. R. R. on which the bridge that contains these floor-beams is located; he fully approved the plans, and finally, the bridge itself, which he pronounced the best bridge in New England. I have it from the Vice-President of the railway, that at the time of receiving proposals for the bridge, the plans were all submitted to Mr. BUDDINGTON, as Engineer of the railway company, with instructions to go over them carefully, and if he found any weak points to report to him just what they were. He reported the plans and strain sheets all right, and recommended their adoption, I was then notified to come to New Haven, where the contract was awarded. Mr. BUDDINGTON was called into the President's office, and in the presence of the President, Vice-President and myself pronounced the plans all right, and before the bridge was built a full set of working drawings was sent to the railway company, which, I believe, were always kept on Mr. BUDDINGTON'S office table during the progress of the work, and he as engineer in charge of the erection of the work never opened his mouth to find

fault with any part of the bridge, for nearly two years after it wa completed. Since then he very suddenly quit the employ of the railway company, and after serving a short engagement with a Bridge Building Company was dismissed in the "interests of good bridge engineering," and he is now attempting through a petty spirit of animosity, backed by a morbid desire for notoriety, to throw discredit on an official, who at the start gave him every opportunity to rise to the front of his profession.

Very respectfully, J. R. JONES,
Late JONES & BENNER, Engineers & Contractors.

"The Unsafe Floor Beam."

TRENTON, N. J., July 5, 1887.

EDITOR ENGINEERING NEWS:

I recently noticed an article in your paper of June 25, 1887, over the signature of J. E. BUDDINGTON. He says the bridge in which the defective beams occur was built some two or three years ago to replace a *cast-iron* structure that had been found to be critically defective in design.

I would here state that I constructed in the year 1871 for the New York and New Haven R. R. Co. an iron bridge across the Housatonic river, consisting (measuring from center to center of piers) of three spans of 168 ft. 4 ins. each, one pivot draw of 206 ft. and two spans of 190 ft. each.

This bridge was to be strong enough to bear a uniformly distributed load of 5,000 lbs. per lineal foot, without straining the wrought-iron beyond 8,000 lbs. per sectional inch, when there was but one bar at a point, 10,000 lbs. when there were two bolts and 12,000 lbs. when there were four or more bolts at a point.

When the bridge was completed it was tested as near as possible according to the above. I recollect particularly about the 168 ft. 4 in. spans. Bars of railroad iron weighing (as the supervisor of the bridge informed me) about 60 lbs. to the yard, were used, between the tracks at the center and were piled three courses, 48 bars, in each track 14 bars and outside of each track 9 bars each in three courses. The balance of the load consisted of dump cars loaded with gravel and weighed. In justice to myself I ought to have had some one stationed to see that no more gravel was placed on the cars than was called for; but at all events there was doubtless quite enough.

With this load of 420 tons placed upon the bridge the depression at the middle, or center, was just 1¼ of an inch.

Now I have found that in testing several thousands of bars of iron with a load of ten gross tons (22,400 lbs.) to the sectional inch of metal, the bars elongated just $\frac{1}{8}$ of an inch in every 5 ft. of their length. Now it must be borne in mind that, with the above load on the bridge, all of the main diagonals and lower chord rods were to be strained up to 12,000 lbs. per inch. The bridge was, this part of it, 22 ft. high, it had vertical end posts, and the number of panels were fifteen. Now I contend that a better evidence of the strength of this bridge than the small amount of deflection of 1¼ ins. cannot be given.

The gravel cars were removed, the rail road bars being left on, and a locomotive was placed on each track, which increased the load to at least from 10,000 to 12,000 lbs. per lineal foot, or more than double the amount contracted for. With this load, the depression in the middle was 2¼ ins., and it nearly recovered itself on the removal of the locomotives.

The bridge proved satisfactory and was accepted and paid for.

I think it was about two years after the completion of the bridge I received a letter from the Hon. H. D. BISHOP, the President, stating that a Mr. BUDDINGTON, a graduate of the New Haven College, had been investigating the bridge, and found it was not sufficiently strong, and that it was backed up by the professor. I went over and met Mr. BISHOP and Mr. REED on the bridge, when the latter says to me, "Mr. L., there were six locomotives with snow ploughs went over this bridge, three on each track, abreast of each other, which I would not have allowed had I been here." But this load was not nearly so heavy as the one used to test the floor beam. In fact they might have filled the bridge with them, and they could not have equalled the test of that floor beam.

I obtained a copy of BUDDINGTON'S diagram of strain. Mr. REED informed me he had engaged Mr. JONES, of the Keystone Co. to investigate and report on the strength of the bridge. (Now I have been informed that this Keystone Co. was a bidder for the bridge but did not get it).

I have copies of Mr. JONES' diagrams and calculations which I were told, was also signed by Mr. LINVILLE; but I do not believe that Mr. LINVILLE ever looked over them, they were so manifestly unjust; for instance, the balance beam was composed of two cast-iron girders, which were connected together, in the upper part of each were 52 in. of solid metal equal to 104 in. which multiplied by 4,000 lbs., the safe tensile load for cast-iron, equals 416,000 lbs., and there were two rods to each girder placed there to assist the 104 in., of cast-iron in supporting the bridge which JONES ignored. Again the upper chords as also the posts were much larger in their middle than at their ends, whereas JONES only took the diameter of the smaller ends as his guide. He also put the same strain on the posts as he did on the diagonals, which was wrong. The fact is the whole thing was unjust and unfair. I wrote to Mr. REED and I told him of these blunders of Mr. JONES.

So far as BUDDINGTON is concerned his calculations varied from 30,000 lbs. to 40,000 lbs. in single panels from either Mr. JONES' or my own calculations; and I am satisfied that he was greatly in error; but how his calculations may hold in the present case, I do not know; but I think the officers of the N. Y., N. H. & H. R. R. Co. may find they will have good reason to exclaim with the late HORACE GREELEY, "From college graduates, good Lord deliver us."

One thing is certain, that bridge was not allowed to be taken down for thirteen years, while Mr. BISHOP was President. And there has been no such increased weight as to render it necessary.

To show that mathematicians will sometimes make mistakes I will state the following. I had charge of the first 12 miles of the P. R. R. above Harrisburg on which were several bridges, among which was the long one over the Susquehanna river. This bridge had 23 piers and abutments all of which were askew, and the east end was entered by a curve over three arches of 26 ft. span each, of course it was difficult to lay out and to calculate. I received from Mr. WM. B. FOSTER the Associate Engineer, a most flattering testimonial for as he says "The able manner in which that large mass of askew masonry was laid out and carried up." One day when I was in the office of the Chief Engineer Mr. J. EDGAR THOMSON said to me "Mr. L. I wish you would look over your calculations of the bridge masonry, I think there is a mistake in them," to which I replied "I hardly think there is, for I was very careful in making them." I looked them over very carefully and then went to Mr. THOMSON and said, "I would like to know where the mistakes were as I could find none;" and he, turning to Mr. HERMANN HAUPT, (who as I had been informed had been professor of mathematics in Gettysburg College) says "You had better look those calculations over again," and I had the satisfaction of hearing him say "I find I have made a mistake myself."

The Catasauqua & Fogiesville Railway bridge across the Jordan creek and valley was built 30 years ago, and is now apparently as good as it was when first put up. It is 1,120 ft. long and 89 ft. high from top of rail to the surface of the creek. This bridge was tested with a load of 2,520 lbs. per lineal foot, it was a single track bridge. After the testing I met the President, the late Mr. DAVID THOMAS of Catasauqua and the Chief Engineer Mr. EDWIN A. DOUGLAS. Mr. THOMAS came up to me and placing his hands on my shoulder said "Mr. L. it is my plan to hold men down," and then added, "I have felt very uneasy about this bridge because Mr. JOHN W. MURPHY, Civil Engineer *assured me* that it was *utterly impossible for this bridge to carry a greater load than half a ton to the foot.*" Now Mr. MURPHY, like Mr. HAUPT, was considered an excellent mathematician; but unfortunately they both made mistakes.

But why does Mr. B. call my bridge a *cast-iron* one? He can, with equal propriety, call the Phœnix Bridge Co.'s bridge a *cast-iron* one, as all of its connections are of cast-iron.

You, yourself, Mr. Editor, must recollect the test made at Munich, in Germany, a little over a year ago, in which columns of wrought and cast-iron were placed in position, loaded and then heated till red hot. When water was thrown on them, those of cast-iron bore the load, while those of wrought-iron failed.

The Board of Judges of the Centennial Exhibition awarded me a diploma and medal. They say: "This engineer has in many instances made the parts of his bridge under compression of cast-iron, using wrought-iron for those parts subject to extension, a method which has been adopted in *many cases* in Europe. But it is now much less used than formerly, engineers generally preferring to make their trusses wholly of wrought-iron. There are, however, in England, bridges in which cast-iron is used for compression strains, over which the *heaviest railway traffic has been passing for forty years.*"

The above was signed by the Judge, JOHN HAWKSHAW, and the rest of the Commission.

The Newark Bay draw was constructed some 23 years ago to carry a load on each track of 2,000 lbs. per foot lineal, without straining the wrought-iron beyond 10,000 lbs. per foot. Subsequently additional stringers and longer cross ties were added which greatly increased the constant strain on the diagonals and posts which were not enlarged accordingly. Yet notwithstanding this, for several years past the heaviest kind of locomotives and trains have been crossing this bridge, the locomotives alone weighing upwards of 50 tons.

I feel glad to learn that this bridge is being taken down to be replaced with a stronger structure; yet it has acted its part nobly.

The public road bridge over the Lehigh at Easton, Pa., was erected during the last of the year 1862. It consisted of two spans of 132 ft. each, two wagon ways and two foot walks. In this bridge the floor-beams were of cast-iron. I was told that during the rebellion the troops marched over this bridge, keeping step to the tap of the drum, whilst it was crowded with people.

As to my ability for calculating bridge strains, I give the letter which follows this.

Yours truly, F. C. LOWTHORP.

Department of Surveys, Office of Chief Engineer & Surveyor
PHILADELPHIA, PA., Sept. 4, 1858.

It gives me great pleasure in being able to state that I believe the arrangement of material for an iron Truss Bridge, as designed by Mr. LOWTHORP has very many advantages that is not possessed by any other plan of iron truss bridge, both for economy and the proper disposal of materi l; and feel strengthened in my opinion from my examination of many plans, in conjunction with a commission on bridge plans, appointed by the city of Philadelphia, which commission allotted to the plans submitted by Mr. LOWTHORP the first premium of $100.—they say in their report in allusion to Mr. LOWTHORP'S plan. "It is well proportioned in all its parts, which are so disposed as to afford a maximum of strength with the smallest amount of material, having such arrangement for adjustment as to give to each and every part its proper functions to perform, without requiring *great experience* for its proper care." This was signed by J. Edgar Thompson, Ashbel Welch and John C. Cresson, in whose opinion I have unbounded confidence, irrespective of my own conviction on professional experience. Very Truly

STRICKLAND KNEASS,
Ch't Eng. & Surv. of City of Philadelphia, Pa.

Answers to Correspondents.

FRANK L. KIMBALL, M. E., Greensburg, Pa., with regard to wire rope haulage for mine use. We know of no especial treatise. A number of valuable papers on this subject have appeared from time to time in the Proceedings of the Institution of Civil Engineers, of London, one of which we reprinted on Jan. 1, 1887. For your purpose, as we understand it, Roebling Bros., or any reliable maker of wire rope would furnish the information required. For making blue prints you will find full directions in our issues of Nov. 27, 1886, and following, and you will find an illustration of an excellent printing frame in our issue of Feb. 19, 1887.

H. H. G. Fort Wayne, Ind. The above will answer your query as to the "blue process," for the best is there described. As to the "Black process," the method is described by Mr. A. FISCH, in the *Photocopic* and a translation in full is given in ENGINEERING NEWS of Dec. 25, 1886. We are not aware that any one has the exclusive right to use it in this country or can prevent an engineer from employing it in his work.

ENGINEERING NEWS

VOL. XVIII. Saturday, July 9, 1887.

D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

THE very decisive and expeditious manner in which the citizens of Philadelphia have sat down upon the elevated railway scheme in that city, when it was presented to them in a tangible form, is rather amusing, when we consider the previous loud demands for rapid transit "in any form" made by the press and the people.

And the Consolidated Transit Co., which only a few days ago was so anxious to build, has so far obeyed the popular voice as to withdraw the bill pending, and instead it recommends the appointment of a commission "to report upon the necessity for elevated roads in Philadelphia, the best routes for such roads and to devise proper means to protect the rights of the city and property owners and to secure just compensation to them."

The latter considerations would be deemed somewhat novel in this city, so far as elevated railway structures are concerned, as the rule here has been to sink the individual loss in the general gain. At least that is the promotor's statement of the case. Philadelphia is already better provided with surface railroads than perhaps any city in the world, but its 130 sq. mls. of territory also undoubtedly require more rapid transit than now exists, and the late attempt to supply this need brings out prominently some of the peculiarities of that city. The majority of citizens of the Quaker City own, or expect to own, the houses they live in, and therein lies the trouble. Every one is very anxious to have rapid transit, and would even be satisfied with an elevated railroad—but each citizen wants it to be located on the "next street," anywhere in fact except in front of his own door.

The small streets, or alleys, which very generally intersect the Philadelphia blocks of 600 ft. square would, however, seem to offer a solution to the elevated railway problem. These secondary streets are mainly occupied by cheap houses that are as a rule rented and not owned by their occupants. A road upon these streets, while it would require the purchase of some property to give a continuous line, would leave the prominent thoroughfares unincumbered except where the street is crossed. And where property has to be bought the first story and those above the road could still be utilized for purposes of trade or industry, somewhat after the manner proposed in Paris. If the contemplated commission should decide that elevated roads are really essential in that city, we would advise them to study these "alley routes" which do not seem to have been considered in the right-of-way so far demanded.

THERE seems to be an irresistible fascination about delving for Capt. KID's buried treasures or diving for Spanish doubloons that at longer or shorter intervals leads some one to invest dollars in hand in the quest after prospective treasure in the bush, or under the waves. The latest enterprise of this nature is the fitting out of a schooner in Philadelphia for the search after the wreck of the English privateer, DE BRAAK, supposed to have been sunk near the Delaware breakwater in 1798, in company with two Spanish prizes containing $1,000,000. Late investigations in London and local tradition point out the "exact spot" where these wrecks are to be looked for. If they are there and modern wrecking pumps are of any avail in such cases something will be done. In addition to divers the Submarine Co., which has fitted up the schooner, expects to use a pump capable of lifting 25 or 30 tons per hour from the bottom and pass whatever is lifted through a seive that will catch any valuables. Treasure hunting would amount to something if we had any prospect of now and then uncovering pits filled to the brim with coined rupees and jewels of great price to the value of $28,000,000, as lately reported from India; or like the hoard of the thieving Grand Vizier of Morocco, which the Sultan is just stated to have confiscated "for the common weal" and which is given "in round numbers as amounting to $90,000,000."

THERE appeared lately in a Philadelphia paper a letter from a man whom we happen to know is eminently qualified to discuss the subject on the great question of how to eliminate the Hudson river from the New York terminus problem from which we make the following extracts, as of general interest; especially in view of the fact, which we happen to know, that the problem is now being studied over with very lively interest and very practical intentions:

> Are the proposed tunnels under the river the proper remedies for the present inconveniences? The projected tunnel is estimated to cost $11,000,000 for two tracks. But two tracks would not begin to accommodate the passenger business of a single railroad, much less all that now terminate on the Jersey side. The Pennsylvania Railroad alone would require four tracks for its steadily increasing business. There should be not less than six tracks, requiring six tunnels. Assuming that six tunnels with corresponding terminals were built to meet the existing demand for travel at the estimated cost for two tracks, then the cost for six tracks would be $33,000,000. That the cost would be much greater can readily be believed without going into details. Six mud tunnels for necessarily slow trains with noisy, cramped terminals, from which dampness could not be excluded for $33,000,000, with no assurance that this amount would be sufficient, and with the certainty of great expenditures for maintenance and repairs, for tunnels must be pumped dry, ventilated, and perhaps thoroughly lighted. This is certainly not the kind of improvement that New York City is most in need, and it is not the kind of terminal railroad station which could meet the ever growing demands for greater convenience, safety, comfort and expeditious travelling.
>
> Imagine now, in a central part of New York City, within a stone's throw of its greatest avenue, a grand, imposing station, combined with every convenience and comfort of a first-class hotel, with numerous tracks and platforms, accommodating thirty trains at one time, arriving and departing, having all the elevated railroads running their trains directly into this station. Then imagine a massive stone viaduct and lofty columns supporting a six-track roadbed, through and over blocks of buildings to a magnificent bridge over the North river, leaping with a single span over its entire width, without a pier or other obstruction and with a clearance above highest tide of 140 ft., carrying six tracks. Then imagine the six tracks continued on a viaduct and gently descending to the level of the country in New Jersey to connections with all existing railroads and for future lines that will be built. No doubt such imagination may seem fantastic and profitless, though everybody will grant, were it possible to realize such a project, it would be a grand and eminently useful undertaking. But such a project, can be realized. It is perfectly feasible and practicable to execute it at less cost than the proposed tunnels with corresponding terminals. The matter has been studied with the greatest possible care for a number of years, and all conditions have been weighed impartially and soberly. There cannot possibly be objections to a bridge spanning North river without a pier in the river and at such height as to allow the largest steamers to pass under it freely. Bridge engineering has progressed so much that such a large bridge can be built with greater facility to-day than it was possible for the Brooklyn Bridge when it was proposed.

The closing claim is a broad one, but we are inclined to believe it is justified, and with much that is said as to the objections to long tunnels for heavy traffic we must confess we sympathize. For city use experience strongly indicates that they are not advisable, and now that elevators have been brought to such great perfection and are so almost universally used, the high elevated railway passing by long spans entirely over buildings of ordinary height and not obstructing nor occupying the street nor street front at all seems likely to be the rapid transit line of the future, and that such a line would fit in admirably well with a high bridge over the Hudson is evident.

Railroad Building in 1886.

We publish this week the first of our series of railway construction maps, and would call attention to the very interesting facts which are presented by it in a clearer and more forcible manner than has ever before been done.

In the first place, the black lines of the map show *all* the railroad lines included in the area, and show them as they stood on Jan. 1, 1886. We have thus, the *geographical distribution* of our American railway mileage shown at a glance, and the sections as yet without transportation facilities and those that are now thoroughly "gridironed," are brought out with striking clearness. Three great areas of the Appalachian region are seen to be still little touched by railways; northern Maine, northern New York, and, far larger than either of the others, the mountain belt of the South, extending from the headwaters of the Potomac to central Tennessee, and nearly 200 miles in width. The railroad belt of the South lies between the mountains and the coast region, but the lines are widely separated and consist of great trunk lines with short feeders —roads whose extension has never extended. Compare the "loose ends" in and about northern Georgia with the network that covers Illinois. Plainly, the development of Southern railways has just begun, and a profitable field for capitalists, engineers and contractors must exist there for a good while to come Passing west of the Mississippi we find that northeastern Texas and a portion of Arkansas have a fair amount of mileage; but except this, these two great States and all of Louisiana and Indian Territory are still almost untouched by railways.

In the great area between the Mississippi valley and the Pacific coast the six transcontinental lines wind and curve laboriously across plains and mountains, not at all in the cheerfully direct course which each pursues on its General Passenger Agent's map. About certain centers, too, little systems have gathered. Health seekers and wealth seekers have started a net work about Los Angeles. About San Francisco a larger system centers. There is the beginning of the same thing about Portland, Ore., in Southeastern Washington Territory, and around Salt Lake. Colorado mining interests have built up a good sized system in that State; much of it, however, is still narrow gauge.

The main purpose of the map however, is to exhibit the extensions of American railways in 1886, and this is shown by the red lines in a striking manner. The eye is attracted at once by the network that was laid down in southeastern Kansas. Almost all of this was built for the Missouri Pacific and Santa Fé systems. Nebraska was also the scene of active work, principally done by the Burlington system, though the Chicago & Northwestern's Fremont, Elkhorn & Missouri Valley system built several new lines in the northern and eastern part of the State. To this latter is also due the line into the Black Hills, and the long Wyoming extension, which is generally conceded to be the Northwestern's move toward a terminus on the Pacific coast, as was outlined in these columns a few weeks ago. The other transcontinental extension mentioned in the same article, the St. Paul, Minneapolis & Manitoba's line to Great Falls, is seen in northern Dakota about half way between the Canadian Pacific and Northern Pacific roads. Just east of this, the line making the sharp turn to the left is the Northern Pacific's Grand Forks extension, which it is now clear, was the first move toward the road which is to compete with the Canadian Pacific for Manitoban traffic. South of this the Minneapolis & Pacific is seen, stretching from the "Twin Cities" into Dakota. Other Minnesota and Dakota lines are due mainly to the Manitoba, the St. Paul, and the Northwestern, three principal competitors for the traffic of this rich wheat raising country.

Looking farther south we see the three new lines built last year to provide further connections between St. Paul and Chicago. The Minnesota & Northwestern, crossing Northeastern Iowa and Northern Illinois; the Chicago, Burlington & Northern, following the Mississippi Valley; and the Wisconsin Central's extension to Chicago, built because of the rupture of former relations with the St. Paul system. East and southeast of Chicago the extensions are no longer in groups and are generally the work of many different companies. Pennsylvania shows a great number of short lines, due chiefly to the coal interests. The South shows the beginning of the remarkable activity now in progress there. Florida was a center of great activity, being one of the first States taken up by northern enterprise and capital. Texas companies did a fair amount of work, mostly, however, in the vicinity of the railroad centers in the northern part of the State.

The right hand diagram across the upper portion of the map shows the relation of the work done in successive years. The increase of last year over the mileage laid in 1885 is a variation exceeded only by the sudden falling off from the great activity of 1882.

The left hand diagram, showing to what systems the mileage of last year was added, is a noteworthy exhibit of the increasing strength of the great transportation systems. The three aggressive corporations at the head of the list own nearly one-third of the total mileage of last year. In the present year the Santa Fé and Manitoba will contend for the lead, while the Gould system will come farther down the list.

The tracklaying of 1886 was generally within or upon the edges of the railroad belt. The present year is showing bolder moves and the opening up of wholly undeveloped country will be a chief feature of the work.

For convenience of reference we add a table giving the new mileage of last year due to the several States and sections, the latter corresponding to those of our railroad columns as now arranged.

STATE.	MILEAGE.
Canada	300
Maine	17
Massachusetts	16
New York	111
New Jersey	23
Maryland	33
Pennsylvania	174
Ohio	98
Indiana	81
Michigan	174
East of Chicago	727
Virginia	39
West Virginia	98
North Carolina	194
South Carolina	107
Georgia	128
Florida	296
Alabama	69
Mississippi	155
Tennessee	29
Kentucky	76
Southern	1,191

STATE.	MILEAGE.
Illinois	345
Wisconsin	393
Minnesota	520
Dakota	670
Nebraska	678
Iowa	457
The Northwest	3,063
Missouri	79
Kansas	1,561
Indian Territory	79
Arkansas	61
Louisia a	9
Texas	536
The Southwest	2,327
Wyoming	131
Montana	16
Idaho	14
Washington Territory	171
Oregon	43
California	274
Colorado	43
New Mexico	35
Arizona	82
Rocky Mountain and Pacific	809

An Early American Engineering Journal.

Chance has thrown in our way an odd volume of a periodical, probably forgotten by the present generation, but which well deserves a place in professional literature as an able pioneer in a field now covered by a multitude of technical publications. This is *Appleton's Mechanics' Magazine and Engineers' Journal*, Vol. II, 1852. In its editor, Mr. JULIUS W. ADAMS, we recognize the name of an honored civil engineer still actively engaged in professional work; and, if for nothing else, this chronicle of the engineering of a generation ago would be most interesting simply as an index of the phenomenal advances made during a part only of the active life of one individual.

The volume is a quarto, issued monthly, handsomely printed and illustrated in a manner that would be very creditable even in this day of cheap and rapid reproduction and plate-making by processes then unknown, or at least unapplied. Mr. ADAMS and his publishers, the Messrs. APPLETON, made excellent use of the laborious wood-engraving and the more expensive copper-plate, practically the only means of illustration then available.

In his introductory to Vol. II the editor in summing up his contemporaries says that there were then only two scientific journals in this country, *Silliman's American Journal of Arts and Sciences* and *The Journal of the Franklin Institute*. The first was a bi-monthly not exclusively designed for the use of engineers and mechanics, and the second was a monthly which recognized and catered to this particular class but gave too little detail. Among the mechanical papers then extant, the *pseudo-scientific* publications, he notes the *Railroad Journal, The Scientific American, Farmer and Mechanic, The Plough, Loom and Anvil, The Artisan* and several of lesser note but of the same tone. These were weekly papers. The *Railroad Journal* is mentioned as the "only work of its kind in the country" and had the merit of confining itself strictly to its particular field of gathering railroad statistics, reports, etc., and had a daily increasing demand as a work of reference in this direction, but laid no claim to being a mechanical paper. In addition to this mention is made, during the course of the year, of the *American Railway Times*, of Boston. The *Scientific American* was characterized as peculiarly an Inventor's paper, with a good amount of "readable mechanical news." The other papers were intended mainly for circulation in the agricultural sections of the country. Mr. Adams proposed to labor in a field midway between the purely scientific and the merely mechanical journal and included the engineer, the architect and the mechanic in his clientage.

We almost envy the scientific man who has lived *through* the wonderful generation that has passed since this journal issued its first number. And, as can well be imagined, its pages chronicle events and ideas that, wonderful as they then appeared, are very ancient history to us now. One of the items in the January number is a long account of the successful laying of a submarine electric cable from Dover to Calais and the public rejoicing that resulted from the accomplishment of an engineering feat whereby "Paris was put in direct communication with the English Court." This cable was practically the first submarine cable to give complete satisfaction and owed its success to its gutta-percha covering and to the fact that it was a four-strand cable instead of a single wire, as had been its failing predecessors. And while the editor asks "who will venture to fortell the possible results of this submarine electric telegraph," he has lived to see it belt the world to all intents and purposes. In the same issue with this Dover-Calais success is the further announcement that some experiments had just been completed whereby gunpowder was fired by means of the electric spark, and the possible great importance of this discovery in mining and engineering operations was pointed out.

Space forbids a more detailed review of this interesting volume, but as we turn its pages we note that Colt's revolvers, American reapers, the yacht America, the contemplated erection of the Niagara railroad suspension bridge, etc., were then live topics. Cast-iron street pavements on the Roosevelt and the Russ systems were being actively discussed and foot-bridges were recommended over Broadway to enable the pedestrians to escape the crush of omnibuses. But stranger still to some, for many think of it only as a very modern idea, we have described in full the plans of a "municipal," or fire-alarm telegraph as actually put into use in Boston by Dr. WM. F. CHANNING and MR. FARMER. In another number Mr. ERICSSON speaks of his caloric engine, and one of the most interesting sketches of this eminent engineer that we ever saw, explains in part the prevalent idea that Mr. ERICSSON is older than the 84 years he really numbers. The explanation lies in the fact that he commenced the *active* practice of engineering at the early age of 13 years, in 1816, and from that time forward has been identified with the great advances made in almost every branch of engineering.

Under the proceedings of scientific societies we find the Wa-ca-ma-ha-ga Club, of Brooklyn, which is, spite of its name, devoted its time to the discussion of scientific and engineering subjects. Among the bridges described we have the Whipple-truss and the McCollum and other types of wooden trusses —and a correspondent in discussing iron *vs.* wood for ships, figures out to his own satisfaction that wood is best and hopes that the use of iron in ship-building will be "forever abandoned," owing to the rapid fouling of the bottoms of ships so built. But we must shut the volume and look forward to the day when some coming editor will discuss ENGINEERING NEWS much after this same fashion.

THE Isthmus of Corinth canal was commenced in 1882 and was to have been completed in 1888. But the company have just obtained an extension of three years owing to grave mistakes made in testing the strata to be cut through. Rock instead of sand and gravel has been encountered in certain places and the slopes have been made too steep as a rule throughout the canal.

Nineteenth Annual Convention of the American Society of Civil Engineers.

The Hotel Kaaterskill Convention of this year, which closed this week, has undoubtedly been one of the most successful which the Society has ever held, and by much the most largely attended. As the map published in ENGINEERING NEWS of last week will show the point selected was favorably situated for a large attendance and some 350 members and ladies were present. Besides those announced in our list of last week the following members and others attended the convention:

ALLEN, C. F., Socorro, N. M.; ABBOTT, E. L., New York; ADAMS, J. L., New York; BISHOP, G. H., Middletown Conn.; BRACKENRIDGE, W. A., Brooklyn; BATES, T. W.; BOOTH, W. F., Poughkeepsie, N. Y.; BURROWES, G. W.; CHURCH, B. S., New York; DAVIS, CHAS., Pittsburg, Pa.; DOANE, G. B.; DURHAM, C. W., New York; EMERSON, G. D., Rolla, Mo.; FERGUSON, W. J.; GOODWIN, H. S., Bethlehem, Pa.; GREENE, J. N.; HUNT, C. W., New Rochelle, N. Y.; HAGEMAN, W. W.; HAMMOND, A. B.; KELLY, W. D., Jr., Tarrytown, N. Y.; KEEFER, THOS. C., Ottawa, Can.; KNAP, J. M., New York; LEEDS, A. R., Hoboken, N. J.; MASON, W. P.; MILLER, J. IMBRIE; MACLEOD, JOHN, Louisville, Ky.; MARTIN, T. C., Editor *Electrical World*, New York; MCNULTY, G. W., New York; MIER, E. D., St. Louis, Mo.; HERR OESINGER, Attaché German Legation; PIERSON, E. F.; PAINE, A. B.; READ, R. L., Cincinnati, O.; REA, T. B., Pittsburg, Pa.; SMITH, T. G., Buffalo, N. Y.; SWAIN, G. F., Boston, Mass.; SMEDLEY, SAML. L., Philadelphia, Pa.; TAILLEY, J.; WILSON, H. W., Philadelphia, Pa.; WHITTEMORE, D. J., Milwaukee, Wis.; WHITNEY, F. O., Boston, Mass.; WARD L. B., Jersey City; WINGATE, C. F., New York.

Certainly those who attended had reason to rejoice. The Convention chanced to come at very nearly the hottest "spell" of the year, if the past is any evidence of what is to come. Had the Convention been set for one day earlier this would have been wholly escaped. As it was, those who took the already well loaded Albany Day Boat at 22d. St. for the trip up the Hudson on the morning of July 1, came as near to having an uncomfortable ride up that noble river as is often possible. The wind was south, as it is apt to be in hot weather, and the consequence was that there was rather more breeze when the boat was standing still than when it was in motion.

What between the crowd and the heat and the time naturally given to greetings few gave much attention to the prospect (other than the prospect for a seat in the dining hall, which many found to their cost was a poor one indeed) and so far as the scenery was concerned the trip might almost as well have been on the Erie canal. But the party was a jolly one nevertheless, and when what is to be the great Poughkeepsie bridge was reached, responded vigorously to the prolonged and lively greetings from the whistles of all the tugs in the river, which are for the most part in the service of the Union Bridge Co. The party was landed at Rhinebeck, loaded onto the little ferryboat, which they completely over ran, and after what seemed an interminable and unnecessary delay (largely because of the baggage), finally reached the cars at Rondout, a decidedly wilted party, that being one of the hottest possible corners to be in on very nearly the hottest possible day.

An hours ride or so on the Ulster & Delaware took the party to Phœnicia, where a change was made to the narrow-gauge cars, and a little longer and much more picturesque ride in the latter soon took the party above the intenser heat. Nevertheless, if the truth must be told, it was "very unusual weather" on the mountain also. The Society has a knack for striking unusual weather. Those who were on the trip last year will remember that it struck it—and so to speak, struck it rich—at the Denver Convention, Denver had never known any thing like it before, nor had any of its visitors, and it was much the same at Kaaterskill. The hot weather decidedly marred the first day's proceedings, and the only consolation was that it was probably hotter down below and that the nights were cool and breezy,—to those who were fortunate enough to have rooms on the back of the house.

The kindness and forethought of the Committee of Arrangements had provided the ladies at least with a partial corrective for the heat, a mixture of ice-water with straws and green leaves, "with the compliments of the Committee," which with excellent good judgment had been previously placed in every lady's room. A mysterious notice had also been circulated that "members were requested to go immediately to the rooms assigned them, without registering, and after making their toilet, and without waiting for their baggage, to assemble around the flag-staff where special exercises would be held." The "special exercises" were certainly an unexpected and delightful feature. On a small platform stood the Committee of Arrangements and the President. The Chairman of the Committee, Mr. WM. S. HAMILTON then delivered with admirable clearness and *esprit* the following address:

MR. PRESIDENT:

Ladies and gentlemen and guests, members of the American Society of Civil Engineers, on behalf of the Committee of Arrangements, I welcome you to your new home for the coming week.

We have safely passed over the stormy Tappan Zee; skirted the passes of West Point, bristling with cannon; pilloted with skill the shores of the Dunderberg, and climbed the mighty ascent of the Appalachian chain.

Creation is before you. Liberty guards the portals of the Hudson,—the engineers, the summit of the Catskills. Our Surveying Corps reports that we are safe, though encircled by "dears."

Your flag of possession will float over your heads as a token of your mastery of the situation.

In the study of your profession and in the search of the known and unknown take squatter sovereignty of the glades and glens. In your visits to the woodlands let the trees and rocks be the only confidants of your philosophical discourse.

When treading the rustic paths or crossing the mountain streams go two by two of assorted sexes, so that you can fully appreciate the proportions of the Cantilever system, or can't-I-lover form.

Luna, at our request, being full of light, will beam on you with loving rays. Later on we will have learned practical treatises on Poughkeep-*sie* bridges, which, we trust, will not prove Bridges of Sighs.

We hope to treat you to a feast of reason and a flow of soul, where the learning and eloquence of our brethren and sisters will cast new glory on our society, and pass to posterity sweet memories of this our Nineteenth Annual Convention.

In welcoming you to this beautiful spot we hope, laying aside all cares of the outside world, we may worship Nature in all its loveliness and in close communion.

To sustain you in this arduous task forget not to partake liberally and with punctuality of the viands which will be hourly set before you. To revive your *spirits* let not engineering qualms act as a bar against the search of mixed quantities and potentials. Lean upon each other without dissimulation; assist each other in treading the winding ways or scaling the giddy heights.

Hoping that your committee may, in all things, warrant your approval, and that this meeting may be *cemented* by bonds of stronger friend-hip, and that your flag may long wave over the deliberations of this, one of the most enlightened and cultivated scientific bodies in our proud Republic, I bid you welcome in the name of our committee.

"Unfurl the flag and pass the loving cup."

HERE according to programme an attendant slave should have pulled the proper rope and let loose a new and handsome flag presented to the Society by the Committee showing on a white ground an enlarged copy of the blue and gold badge which has become—somewhat to our regret we must confess—the emblem of the Society. The slave pulled, and it was no fault of the Committee of Arrangements that the flag did not "unfurl," but alas, he pulled too well and too hard, and flag, halliards and all came tumbling in a bundle to the ground! Among a superstitious people in a superstitious age it might have been looked on as a bad augury; but the Society, like Hamlet, defies augury, and a shout of good natured laughter did more to break the ice than the flag itself could have done.

But the remainder of the programme did not miscarry. The flag was caught up and displayed as well might be, the band struck up the Russian national hymn, and to that beautiful air the following verses were sung, considering that the whole thing was a total surprise, with very creditable force. The somewhat irregular metre of that hymn will account for the seeming breaks of the rythm:

SALUTE TO THE FLAG.

Annual Convention American Soc. of Civil Engineers, 1887.

First on this mountain height our flag floats to the skies.
And as its colors rise above us, let their hue
Be symbol of that honest faith and life we prize.
And of the earnest work we ever strive to do.

No symbol this of war, nor yet of strife with man;
But badge of victories won o'er Nature and its powers;
Helping by thoughtful art the world to better plan.
Proud that such noble work fills all our busy hours.

Then another new and very pleasant feature was introduced, the passing from hand to hand of a three-handled German "loving-cup," charged with a pleasing kind of sparkling lemonade of which every one was expected to take a share, and few declined to do so. It took some time and several replenishings to pass around the whole party, as may well be believed, although it held about half a gallon, but the party then went in to supper in very good spirits to prepare for the serious business of the next day.

THE FIRST DAY'S SESSIONS.

The Society gathered in very creditable force at about 10.30 in the large hall attached to the hotel. The large attendance is indicated in a measure by the fact that five ex-presidents, Messrs. MCALPINE, ADAMS, GREENE, WHITTEMORE and GRAFF, sat upon the platform beside President WORTHEN. This was nearly all that could have been. Of the 17 presidents which the Society has had, 6 are dead, 2 are absent in Europe, 1—the venerable HORATIO ALLEN—is excusable for his age for not attending any convention, 6 were present, and two only, Messrs. PAINE and FLAD, were absent without known excuse. The ex-presidents paid for their greatness by being placed at first in by far the hottest place in the room, the back of the stage, but even after their early rebellion took them to the floor, they suffered a good deal from the heat, as did the commoner mortals, and the proceedings were much less animated in consequence.

The first business taken up was the consideration of the questions sent out for discussion, as given in an editorial in our last issue. We need not repeat the questions, which chiefly related to the inspection and proportioning of bridges.

Quite a number of written discussions were first read, of which it would be only possible for us to give a brief abstract in this issue if we are to find room for President WORTHEN'S very interesting and instructive annual address, which was delivered on the evening of the first day.

We therefore postpone until next week our report of the other technical proceedings, contenting ourselves with saying that the oral discussion of the questions referred to was not as full and adequate as it might have been and that the afternoon's proceedings were decidedly tame and evidently a matter of duty with most of those present, both speakers and listeners, largely on account of the heat, which made the day an unfit one for such work, although on the piazza of the hotel one could be very comfortable indeed, while enjoying a prospect such as can be had from few other places, which we hope to more adequately picture next week.

In the evening there was a hop, and on the next day, Sunday, services of a peculiarly excellent and appropriate character were conducted by the Rev. Mr. MILLER, Rector of St. Peter's Church, of Philadelphia. Perhaps we ought to report these services more fully, as they were of especial interest to engineers, but as the purely technical proceedings will crowd our columns, it hardly seems feasible to do so.

The next day, being the glorious Fourth, but one formal session was held, in the morning, and the weather having become more appropriate to the Catskills, it was an animated and profitable one, as will appear from our next week's report. Another informal and impromptu one was held in the afternoon, however, which demands early report, as it was certainly a most important one for the welfare of the Society. In the evening of the Fourth there was a grand ball, attended also by guests of the hotel, but the firework display was necessarily postponed until the following day, because of the wind.

ANNUAL ADDRESS OF MR. WM. E. WORTHEN, PRESIDENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

I was much gratified by my election as President of the American Society of Civil Engineers, a numerous body of men who fully represent the profession, and with whom I have been for a long time united. In assuming the office I undertook the duties of the position, which, however honorable, are not entirely without responsibility. I now proceed to fulfill one of the requirements by delivering an Annual Address, which is supposed to be a resumé of what was done last year and the progress of the work of engineers, with some impressions of my own experience and my opinion with regard to the future.

I have collected sundry statistics from newspapers, magazines, etc., and although I have not credited them to the different parties, I yet follow the rule of the Society in their publications, in not assuming the responsibility for the facts and opinions advanced, nor shall I back my opinions against facts if they are hereafter found in opposition thereto.

There is a little of the catastrophic in engineering

science. It is essentially an evolved science, the works and facts from which it is evolved have been the accumulation of centuries; shrewd guesses or judgments worked out; a copying of examples; changing construction according to the teaching of experience, and application of varied material dependent upon location and requirements. Without going back into remote history, when the term engineer was not known, although there were wonderful examples of engineering construction, let us consider the growth of the science up to its present standpoint: Who built the first bridge? The change from wooden to iron structures is recent, yet how full is the record of steps? Who conceived the first railway? Its growth from the strap railway is wholly within our recollection. How many have contributed to make the turbine the wonderfully efficient and economic water motor it now is? Who first thought of the application of steam to the purposes of power? How many worked at the construction and improvement of boilers and steam engines? We can pick out parts that were an essential improvement, and give the names of the men who first designed them, but the great body of the machine is made up of parts which have been constructed by mechanics without name, and not only the parts but the machines to make the parts uniform and interchangeable.

Many an invention conceived before its time could be unearthed from patent records; either because it was not then needed, or the tools which made it economically and practicable were not to be had. How much development of industry has been given by the lathe, planer and shaping machines. Seldom, if ever, in the lapse of a single year can we record any striking novelty which can be set down as a step in progress. It takes years to complete and practically test. Like the statue of "Liberty Enlightening the World," which is one of the accomplished facts of last year, it took many years to design, construct, and raise it. It is unfortunate however, that in illuminating the world no provisions were made for illuminating the statue itself.

The name Engineer is of quite recent date, and is very mixed in its definition: the Architect preceded it. Architecture was always considered among the ancients as one of the liberal arts, but the name of Architect was not given till a few centuries ago to artists charged with the construction of buildings. The man of the profession before the Architect was the Master of Works, a practical builder; and work comprehended the entire building and its furniture. It is probable that the religious houses, which contained all that there were of men of letters, savants and scholars, on the Continent, furnished not only the men who designed and directed the monastic constructions, but also the civil ones and, perhaps military. The Master of Works became the head of a corps of workmen which made a part of these free corporations, which regulated wages and hours of labor, and defined rights and duties. Once outside of the cloister, work went on with great rapidity. The Master Workman was the acknowledged head; his name was connected with his work, and he was buried within the most prominent church he constructed. But the necessities of variation in designs and details soon brought in the artist, and the architect and something beside the construction of buildings was necessary.

In 1560-1641, SULLY, Grand Master of Artillery and Superintendent of Finances of Henry the Fourth of France, was the first that appreciated the service that could be rendered by a body of geometricians and mathematicians, and he organized a *Corps de Genié*, which took the title of "*Ingenieurs Ordinaires du Roi.*" This organization remained unchanged until the time of COLBERT and VAUBAN, the latter the "*vrai pere de Genié Civil et Militaire.*" L'Ecole Nuzieres, established in 1748, was the first institution devoted to the development of the sciences. This was the period when the expression the "*Corps de Genié*" was introduced into the army. In England, the distinction between engineers became that of civil and military. It was evident in the discussion of the paper of Mr. METCALF, on steel, before this Society, that in the application of this material to the construction of guns and to civil purposes, no distinctions were drawn between the civil and the military, and the graduates from West Point are able civil engineers, and fulfill that duty under the direction of the War Department. In general, the term engineer is supposed to come from engine, and the term engineer embraces not only the man who designs and constructs it, but the man who runs it. I suggest that there should be some distinction: that engineers should be such as are eligible to our society, and that the men who run and take charge of engines or machines should be called *enginers*. I want to re-claim, perhaps, a little more of "*le genié*" for the profession than for the mechanical artisan, for skill, experience, and industry may make a very good workman, but to this must be added more general and extended information in the application of materials to necessity, mathematics to calculate, and drawing to express, and more than this, a sentiment of purpose, a feeling for the work. A true engineer is as much born as a poet. Could we divide the application of the term into engineer and enginers, it would be distinctive, and I would drop the term civil as embracing too large a profession, and adopt prefixes as military, hydraulic, railway, mechanical, steam, electric, and other divisions when these are adopted as specialities. With regard to military engineering, I know of no particular progress of recent date. The War Department has undertaken to clear out Gedney's channel, in New York harbor, by pump dredging, and it is satisfactory to report that the work last year retained its depth without filling in, and a new contract has been entered into at about half the price of last year and is successfully progressing.

HYDRAULIC ENGINEERING.

Constructions for the use of water for power, city and town supplies, hydraulic mining, and irrigation. In the census of 1880 will be found tabulated accounts of the water-power of the United States developed and undeveloped. Attention is called to the low percentage of increase of water-power in comparison with that of steam:

In 1870, Water power,	1,130,431 H.P.	Steam,	1,318,711 H.P.
In 1880. "	1,225,379 "	"	2,185,418 "
Percentage of increase	8.40.		79.77.

It will be seen that the percentage of increase of steam is very much in excess of that of water, but it still is not an inconsiderable amount, about 105,000 H. P., equal to the power of the city of Lowell per year. A convenience of access to business and labor centers has tendered very largely to the increase of steam power. And although there are immense water powers yet undeveloped, and the cost of steam power is largely in excess of that of water power, yet position and its relations have decided in favor of steam. And where large manufacturies have been commenced on water power; and where the water power has become exhausted, or very irregular, the business has been extended by the use of steam, rather than by a diversion of it to a new place for water. In 1844 I assisted Mr. U. A. BOYDEN in conducting his experiments on the first four iron turbines at the Appleton Mills, Lowell, Mass. This wheel gave 76 per cent. useful effect from the water, whilst some breast wheels at Lowell, which Mr. FRANCIS and myself tested some time before, gave from 60 to 66. Mr. BOYDEN afterwards constructed many other turbines throughout the country, introducing many improvements in design and construction. One at Lawrence gave over 90 per cent. of effect. Mr. BOYDEN came of a very remarkable family, and had above all men that I ever knew, that desirable genius, the genius of industry. He filled in all his time with scientific work and research. His relaxations consisted almost entirely of changes of subject. His improvements in water-wheels increased the water power at Lowell about one-fourth over what was obtained by the former wheels, and gave him the means of pursuing other investigations of light, heat, sound, etc. His mode of experimenting was that now followed by Mr. FRANCIS at Lowell, and by Mr. MILES at Lawrence. With the impulse given by Mr. BOYDEN, water-wheel shops were established in different parts of the country. The wheels were tested and improvements made, until now water-wheel construction has passed out of the hands of the engineers into those of manufacturers, who furnish wheels, ready made, simple, efficient and strong, guaranteed to give 80 per cent. effective power.

WATER SUPPLY OF TOWNS.

There is a very large increase in the number of towns and cities supplied, and addition to work already constructed. The great improvement in the matter of aqueducts has been in the application of wrought-iron for cast-iron mains to take the place of masonry and tunneling. Large wrought-iron pipes for conducting water to turbines have been in use from the time of the introduction of the Boyden turbine wheel, but it has been left for California to largely extend its use for the conducting of water for hydraulic mining, irrigation and town supply with a boldness of design and execution which has astonished the engineer. The method of hydraulic mining was introduced or invented in California in 1852. The supply of water for these jets at first was conducted through hose made of heavy duck cotton cloth, which was strengthened by outer nettings of cordage when the pressure was large. In 1853, an ingenious miner laid in his mine a line of pipe consisting of ordinary stove-pipe, made of a very thin sheet-iron lightly fastened together with cold rivets, with the joints united stove fashion. This pipe was 5 or 6-ins. in diameter. As hydraulic mining increased in magnitude the sizes of these supply pipes also increased, the diameter for main lines for a large mine being from 22 to 30-ins. These pipes, as a rule, are made at the mine. The iron is from .065 to .134-ins. (No. 16 to 10 Birm. gauge) in thickness, with a double row of cold rivets for the longitudinal seam when the pressure is to be large. As a protection against rust each joint is immersed for several minutes in a bath of boiling asphaltum and tar. They are now used for permanent conduits both for conducting water to mining districts across deep mountain gorges and also for the supply of cities. San Francisco, a place of some 300,000 inhabitants, receives its water through two lines of such pipes, and a third pipe, many miles in length and of large diameter, is now being laid for an additional supply. Within the last year one of the large shops in San Francisco has increased and improved its plant, so that they are now able to turn out weekly a mile of pipe 44-ins. in diameter. Of the quantity of water necessary per inhabitant, there is considerable difference of opinion, but there is no doubt in the general opinion, that in the present use of water there is an excessive waste.

Of the quality of water for a town supply there is a great difference of opinion among chemists and scientists. M. GERARDIN, (*Rapport l'Alteration, la Corruption et l'Assainissement des Riveres*) says the distinction between healthy waters and polluted ones cannot be detected by chemical analysis. Water can be very much polluted without giving any smell, such are the waters of paper mills, starch and sugar works at the leaving of the works. Many natural waters which are prescribed in the case of sickness are very offensive in smell. Chemical analysis does not sufficiently explain the alteration of waters. If a perfectly healthy water be enclosed some time in a bottle, well corked its elementary analysis always manifests the same results, and notwithstanding this it has undergone radical change and has lost all its good qualities.

CHAPTAL says that those who make a chemical examination of waters only analyze its dead body. "Water is healthy when animals and vegetables of a superior organism can live in it; on the contrary, a water is affected when animals die, and it can only nourish infusoria. There is no better means of establishing the charact r of water than by determining if, in this water, fish and aquatic plants can live. If fish die there and plants perish there, the character is certainly polluted, and the water should not be used for domestic purposes. On the contrary, if fish and aquatic plants can live in it the water can be considered good. There is an old French proverb, '*Il n'est pire eau que l'eau qui dort,*' ('There is no worse water than water which sleeps,') which conveys the general impression with regard to the sources of supply. A running stream supplies the best water, and when reservoirs are necessary, the one from which the water is drawn directly should be as small as possible, and the water from superior reservoirs should flow down into it so that the water may be well aerated in its course. Organisms are not dangerous because microscopic, and they are not, as a rule, dangerous. It is only, as an eminent scientist observed, when germs of disease are introduced from the outside, that the waters become dangerous, and organisms actually contribute largely to the purification of the water. If, by the doctrine that water once polluted is always polluted, it is to be understood that these pollutions are accumulations from century to century, then, for the preser-

vation of our species, our own organisms must be changed to adapt us to the circumstances, and, in our new evolution, we should not be suited to the air and water of the garden of Eden and its suburbs. M. GERARDIN, in the work above quoted, speaking of algæ, says they are endowed with a very active respiration. "The oxygen which they accumulate decomposes rapidly organic matter and they contribute largely to the purification of waters polluted by organic matters in decomposition. From the biological examination of the waters of various streams that are polluted by paper mills, and sugar, starch and glue works, as it leaves the works and at different stages of the stream below, he finds that cryptogams and algæ first begin to appear, and thus up through a variety of forms to the higher and higher organisms, until fish appear in its waters and plants along its shore." Experiments in aquaria confirm this conclusion. I would refer to the report on pisciculture of JAMES B. FERGUSON, Commissioner of the United States at the Paris Universal Exposition of 1878, on the value of the algæ. He says "oxygen in its native state resulting from the respiration of vegetable and especially from microscopic algæ is very soluble in water. Atmospheric air introduced mechanically into water is not dissolved there, or if so in very small quantities." He quotes also from the Superintendent of the Aquarium his experiments on the aeration of waters supplied, as follows:

"The water of the Vanne, taken almost from its source, contains consequently little air and no organic germs; hence, although very useful for the cleansing and purification of the basins, it was not suitable to favor the rapid development of a cryptogamous vegetation upon the sides of the tanks. I substituted, therefore, the waters of the Seine, the color of which was, at that time, green on account of the abundance of microscopic germs, sporules of algæ, conferva, and, in fact, all those vegetable aquatics—for the most part microscopic—the presence of which is requisite for the continuous oxygenation of water intended to receive fish. In truth, upon water as well as upon air, has been imposed that great law of nature which counterbalances and equalizes the animal and the vegetable kingdoms, making the one the indispensable auxiliary of the other.

"Fish, as well as animals on land, absorb oxygen by respiration, and give out carbonic acid, the quantity of which always increasing in the place which they inhabit, would not fail to produce asphyxia if the aquatic vegetable were not present to produce a chemically inverse effect. Under the influence of solar radiation the green immerged particles absorb carbonic acid, decompose it, assimilate the carbon, and exhale the oxygen, which appears upon their surface in innumerable small bubbles, supplying the fish with the respiratory element, renewed and endowed with a vital action so much the more efficacious because just brought to life, and possessing a solubility much greater than that of oxygen drawn from the atmosphere.

"Perhaps there is even a formation of bioxide of hydrogen, which would explain this co-efficient of solubility as being so much greater than that admitted by chemists. However, that may be, for me the fact is now incontestible that to establish in an aquarium a hygenic medium suitable for the life of aquatic animals, an abundant vegetation must there be developed, which should frequently undergo the action of solar radiation."

Most successful aquaria are constructed with what may be termed closed circuits, not drawing water from an exterior supply, except to make up waste. Water is used over again by aerating it in its circulation. C. B. BRUSH, Member of our Society, has written a paper which will be read before the Society, of experiments in forcing air into water by means of air pump pressure at the Hackensack Works, as he claims with success.

Whether the cucumber taste of the Croton water be due to the *spongilla lacustrine* or to *nostochoniae*, it seems to me to be rather due to the want of circulation, and the decease and decay of some organism, by which the balance of aquarial life has not been properly kept up. The pabulum has failed, and perhaps it might be remedial to introduce a little sewerage, as it has been shown by analysis that the sewerage at Troy improves the water of the Hudson, and that the water supply at Albany is better than that above. The algae called frogs spittle, *Batrachosperma monilliforma*, (I might here remark the smaller the organism the bigger the name) will always be found in the purest spring water. I am pleased to see them and feel more sure of the purity of water by the presence of such common organisms than by their absence, understanding that within the microcosm there is a class of organism which depends on the usual food supplied by nature. Disturbance means disease if not death. *Post hoc* is not always *propter hoc*; don't at once ascribe disease to the presence of an organism; and when you see crows or buzzards hovering around the carcass of a horse, don't come to the conclusion that they have killed a valuable animal and shoot the crow or buzzard.

In the early times of gold mining in California, hydraulic mining was the rule, but with the increase of value for agricultural purposes, the disturbance of rivers, and the covering of land with debris, this has been found very objectionable, and water has taken a value for irrigation, but with irrigation developments the necessity of defining water rights has become indispensable, and a law was passed creating the office of State Engineer, and duties were assigned opening a large field of inquiry over an immense territory. The field of work is in the nature of a physical survey of the State combined with certain industrial, social and other inquiries of a broad scope, and necessary to be prosecuted over a wide field.

The first part of the report has now come out and is for sale by the State of California. It is introductory to the study of problems of irrigation, and is composed of a series of studies of irrigation development in the three countries of France, Italy and Spain, from whose experience we propose to learn something for our own immediate purposes. We have referred to this report not only for its value in matters treated, but because like necessity exists in all our States to define the rights of water users, whether for power or town supply, the drainage of land for agricultural purposes and sometimes irrigation, and in the discharge of polluted matter from streams. In whom does the title to water lie? Is it the first user? When the large city takes the entire flow of contiguous rivers and streams, whence is the fast increasing suburban population to be supplied and once taken has any town or city the right to deprive others of this by waste? In 1883 an Act was introduced into the New Jersey Legislature, to provide for the appointment of a commissioner to determine on plans for the storage of any of the waters of this State for the purpose of furnishing to cities and towns a joint water supply. With regard to this, commissioners were appointed and a small amount of money was provided for expenses. The report was made up but no further action was taken. The commission is still in existence but without power or money. In 1886 an Act was passed by the Commonwealth of Massachusetts, requiring from the Board of Health a report on the condition and means for protecting inland waters. A report has been made under this Act. This year a new bill was introduced to establish a Board of Water Commissioners, to provide for the establishment of water companies, and the general supervision of drainage connected with inland waters. Such boards are necessary in every State, not only to define the uses of water and the removal of waste within the limits of the State, but also there are interstate rights, and you can readily understand that the majority of such boards should be hydraulic engineers and with such powers as the State can delegate.

STEAM ENGINEERING.

In 1857, Mr. CHAS. W. COPELAND and myself made the first experiments on pumping engines at Belleville, N. J., and Hartford, Conn., (published in the "Brooklyn Water Works" and issued by the City of Brooklyn). It may be remarked that the evaporation of the boilers from water at 100° will still be considered a very fair evaporation. But the duty per 100 lbs. of coal was 55,000,000 to 62,000,000 on the Hartford engine and 68,000,000 to 73,000,000 on the Cornish engine at Belleville, now very much below the duty of first-class pumping engines. From the above experiments Mr. KIRKWOOD felt authorized to require by contract for the first Brooklyn engine a duty of 60,000,000 lbs. per 100 lbs. of coal. It is not now unusual to require 1,000,000 lbs. or 1-H. P. for a little less than 2 lbs. of coal per hour, and this taken on the water end of the machine. First-class pumping engines are now invariably compounded, and compounds have also been largely introduced in stationary engines and with largely economic results; of their exact comparative economy we need more tests.

When steam was first introduced for the heating of cotton mills, a boiler was placed at each end of the mill, with automatic water feed by means of balance float. Later the boilers were concentrated within one house and the steam distributed through ranges of immense mills. The original steam heating pipes were cast-iron, about 3 to 4 ins. diameter, and suspended from the ceiling; later, with the introduction of wrought-iron pipe, the pipe was carried around the walls of the mill, near the floor, but at present the wrought steam pipes are suspended from the ceiling. In mills where large quantities of steam are used for other purposes than power, it is common to pass the steam through a steam engine for power, and then use the exhaust for drying, boiling and heating. In 1866 I made a report to the Merrimack Manufacturing Co., of Lowell, on the economy of using steam first for power at the cotton mills and afterwards the exhaust at their print works for the purposes of heating, boiling, etc., and reported on the advisability of passing the steam through engines of 1,200-H. P., and using the exhaust steam afterwards in the print works, with a back pressure of about 6 lbs., and that the amount of coal properly chargeable to fuel in this case or to power would not exceed 1 lb. of coal per horse power per hour. It was a success and of its present extent the Superintendent of the works writes me as follows: "We have only one pair (34 x 72) condensing engine on our premises, all the others (something over 100 cylinders) exhaust into a system of mains, from which we draw all the heat we require. What we do not require for heat we take into the condensing cylinders, before mentioned, and reconvert into power." Some time since there was a boom in the steam heating of towns and cities from central stations, and many plants were constructed the most of which have gone out. There are still two in New York City, one of moderate size, comparing fairly well in extent with that of a large cotton mill plant; the other is very large and is still increasing its distribution. This result seems to argue the survival of the fittest.

RAILROADS.

There has been substantial progress in the extension of railroads, in the construction of new roads, and doubling and quadrupling the old ones. The estimation of construction for the year is 10,000 miles. The compound locomotive has been tested in Europe, but not sufficiently to afford a fair test of its practical value, and has not been put in operation here. The public has been greatly exercised by numerous accidents in the destruction of cars and passengers by fire, and our legislators have called for a safer means of heating and lighting than at present in use; in New York one year is given for the change. The two great questions of automatic freight train brakes and automatic freight car couplers have made great progress during the past year. The freight brake tests which were made at Burlington, Ia., in July of last year, have been supplemented by a second series this year; the two series together being by far the most complete tests of the kind which have ever been made. The results demonstrated that only air brakes are adapted to the requirements. The prominent part of this year's tests was that taken by electricity as an actuating agent for applying the brakes, with results showing great benefit from its use, both in quickness of stop and in avoiding the dangerous shocks which result from quick stops with long trains. The electric application being absolutely simultaneous throughout the train, no shock whatever results. The occasional failures of the electric apparatus during the test indicated that further improvements are still needed, but as electricity simply supplements the air, which acts as usual in case of an electric failure, the probability seems strong that such electric application will be a feature of the train brake of the future, while a percentage of efficiency was shown in this year's test, much greater than was ever shown before. As a safeguard for human life, rapid progress has been made toward the introduction of automatic freight

car couplers. The Burlington brake tests of this year and last show that it was on the whole decidedly beneficial to eliminate loose slack between trains which has tended to exclude couplings of the link and pin type, and the final step has now being taken by the formal adoption by the Master Car Builders' Association of the Janney hook coupler and others of the same type coupling with it as standards of the association, by a vote of 33 to 14.

STREET RAILWAYS.

The entire service of street railways was for many years by the means of horses, and we quote as to the cost of working: The following returns are taken from the sixteenth annual report of the Massachusetts Board of Railroad Commissioners: Highland, Lynn & Boston, Metropolitan, Middlesex and South Boston; number of horses owned, 6,158; number of miles run, 11,287,196; number of passengers carried, 68,196,776; average number of passengers carried per round trip, 43.4.

From the above it appears that the stable average daily distance travelled by the above horses equals 10.04 miles.

The average number of passengers per round trip being 43.4, per single trip, equals 21.7. Averaging them at 140 lbs., equals 3,038 lbs. Add weight of car, 4,800 lbs. equals 7,838 lbs.

With the great extension of street roads there have been found great inconveniences in this horse service, not only in the cost but in the location of immense stables within populous neighborhoods. The usual traction force has been reckoned to be about $\frac{1}{10}$ per cent. in movement and from 6 to 7 per cent. in starting on level grades. This will afford us a means of comparison between different forms of motors. Although the cable road was used on the London and Blackwall Railroad for many years and for heavy trains, it was superceded by the locomotive, but it has of late years been revived in this country for the distribution of city travel and with great success.

Chicago has 20¼ miles of cable road in operation and 22 under construction; Cincinnati, 8 miles; Kansas City 4 miles in operation and 30 under construction; New York City 10¼ in operation; Philadelphia, 18 miles; St. Louis, 6 miles. San Francisco, 33½ miles now in use; Melbourne, Victoria, has several miles; London, 3 miles, and four years ago a road was built in New Zealand. The first cable road in San Francisco was opened in 1873. This was the famous "Clay Street Hill Cable Road," where the grades were so steep that property was almost valueless. The cables had no trouble with the grades, 17 ft. in 100, where horse power was useless and the road was an immediate success.

Mr. W. H. PAINE, M. Am. Soc. C. E., has furnished me with the following facts in regard to the cable on the Brooklyn Bridge which he laid: "The practicability of applying cables to the hauling of large heavy passenger cars in trains at considerable speed with shorter headway, greater regularity and less danger from accident than any other method known is here demonstrated.

"The durability of the cable, and of the grips and dies has been here so great as to remove a most serious objection to cable traction.

Speed of cable 10 miles per hour.

Length of cable 11,000 feet.

Size of cable 1½ inches in diameter.

Weight 3½ pounds per lineal foot.

"The first cable was taken out last November, after having been in use three years and 41 days, having hauled 1,675,790 cars, 48,108,567 passengers or 22,196,496 tons. The heaviest cars weigh 16 tons when empty, the heaviest load of passengers about 10 tons. The lightest cars weigh 11 tons when empty. Three cars are now hauled in one train. Shortest headway about 1¼ minutes. More than 100,000 passengers have been carried in one day. The grips will last for years with few repairs. The dies or lining of the grips last more than four months, sometimes exceeding 5 months. The speed of the cable, which is 10 miles per hour could be increased, but without increasing the carrying capacity of the road."

ELECTRIC RAILWAYS

for street passenger traffic seem now to be a fixed fact. In Europe electric street railways are now carrying at the rate of 3,000,000 annually, and probably a little in excess of that number and they are extending. The first built was in Berlin, Germany, 1881, 1¼ miles in length. In this country they date from 1885. The following are the places in which they are established in this country. Baltimore, Md., Los Angeles, Cal., Port Huron, Mich., Windsor, Canada, Detroit, Mich., Appleton, Wis., Scranton, Pa., Denver, Col., Montgomery, Ala. In all but one of these the dynamo is driven by a steam engine, but in Appleton, Wis., there is a road of 4½ miles, where water power is used. You may recollect that an eminent divine once remarked as an evidence of design in the works of the Creator, that great rivers were placed near great cities. It were fortunate for the purposes of lighting and heating if great water powers were placed in the vicinity of large populous districts. It has not yet been sufficiently decided how far power can be carried by means of electricity, nor the size of the conductor and the loss in conducting it. With the short roads now in operation it has been said that the percentage of effect on the car is 50% to 55% of that of the steam engine providing the power. In this respect it is superior to the cable, which is fast superceding horses.

Few of the present engineers recollect the experiment of the old atmospheric railway of Samuda, which ran from Dublin to Kingston, about 1¼ miles, successfully for many years; and was later tried in a larger way from London to Croydon and from Paris to St. Germain. It failed and was superceded by the locomotive. It may be that for a moderate distance the atmospheric road may become practicable, but for the present our hopes of a successful motor, especially for city and town roads are based on electricity. So much at least has been directed to this subject, not only with reference to power, but to light and heating that a new branch of engineering has sprung up and has inaugurated itself into a society like our own as the American Institute of Electrical Engineers. From our knowledge of them and their claims I feel satisfied that they are to be a worthy branch of engineers. In our own country capitalization in electrical industries, telegraphic, telephonic, electric lighting and electric power, amounts to a sum of at least $350,000,000. There are in America about 700,000 miles of telegraphic wire; last year 32,000,000 conversations were held on the telephone; there are over 150,000 arc lamps, and incandescents verging on a million, and at least 15,000 electric motors for fans and sewing machines.

BRIDGES.

The first Howe Truss was built across the Connecticut river at Springfield, Mass., in 1840. It was a wooden bridge with double intersection. Smaller bridges had been built in the same line of road, but this was a very important bridge at the time. HOWE was a carpenter and the bridge was designed by average judgment and the construction of one bridge made the precedent for another. Engineering science was not then applied to the calculating of stresses. Undue confidence in the form of truss, and the successful construction of many bridges in wood led to the Ashtabula accident. The strong desire for the construction of iron bridges at minimum cost, and the high price of iron, led to the construction of weak designs of this materjal and postponed its adoption for many years. With the reduction of the price of iron, and a better understanding of the principles of construction, iron bridges have almost entirely superceded the wooden ones. In fact the construction of bridges of common need and spans have passed out of the domain of engineering science and into the hands of established firms that design, build and erect the structure.

THE SOICETY BUILDING.

The most important session held during the convention for the welfare of the Society we may hope, was an informal one held on the afternoon of the glorious Fourth, The present President of the Society, WM. E. WORTHEN has taken great interest in the matter, and made a careful study of the possibilities in respect to enlarging the Society building by extending the house back to cover the entire lot, and building on it a meeting room which would be adequate for its immediate necessities, or some 25 x 60 ft. This room would be two ordinary stories high with a library gallery running around it, and with the present rear room of the library building serving as a sort of gallery to the new meeting room and also as a library reading room. The cost of this change was estimated at $3,500 to $6,000. The Chairman of the Committee of Arrangements; Mr. W. S. HAMILTON, who proved to be so emphatically the right man in the right place in so many other ways, also showed his interest in the Society by intimating his readiness to subscribe $1,000 to a fund for this purpose. At a first informal gathering of a few members, President WORTHEN also offered to subscribe $500, and various others followed. It was then concluded to hold a larger informal meeting of all the members who could be gathered together on the spur of the moment, which amounted to some 70, and the plan was outlined to them. Ex President WHITTEMORE thought that some more ambitions project was entirely feasible with proper effort, in which several others agreed, and the Secretary and others mentioned various plans by which a larger subscription of $15,000 to $30,000 would provide the Society with entirely new and still more desirable buildings. The hope was expressed by a number that no limit should be placed to the subscription, but that an effort should be made to see what sum could be raised, and if the result should be sufficiently encouraging that the Board of Direction should give consideration to all possibilities. Mr. WORTHEN explained, however, that all money expended for the proposed alterations would be money well invested, since it would be all for necessary additions for turning the property into a store, and the more general feeling seemed to be that it would be desirable to raise as large a sum as possible, make the desired improvements, and devote the rest to reducing the mortgage of $20,000 on the property, pending the time when ampler accommodations should appear desirable. The fact was also mentioned that the present house, which had cost $30,000 and was now worth $35,000 to $40,000 had not cost the Society as such a dollar, but was all paid for by private subscriptions, and that it had reduced the Society's former rent of $2,400 to $800 interest charge on much more commodious quarters.

After a few minutes discussion of these matters the following resolution was passed and then one by one the subscriptions following were made, all in about ten minutes, indicating that a much larger sum will eventually be raised:

Whereas: The accommodation of the present Society building is inadequate for the purposes of the Society, and it is deemed advisable without delay either to procure new quarters or an enlargement of the present building:

Resolved: That the members of the Society are urged to contribute to the Building Fund as they may be able, in order that immediate measures may be taken by the Board to accomplish this object.

Resolved: That the Board in its discretion may expend a reasonable sum in an alteration of the present building.

Subscriptions made immediately after the adoption of the above resolution from among the 70 members present:

WM. G. HAMILTON,	$1,000	B. S. CHURCH,	$ 50
WM. E. WORTHEN,	500	F. S. ODELL,	50
P. V. DICKINSON,	100	J. R. WARDLAW,	50
A BONZANO,	200	F. G. DARLINGTON,	50
DON J. WHITTEMORE,	500	E. B. GUTHRIE,	25
PERCIVAL ROBERTS, JR.	200	J. M. KNAP,	100
WM. ROBERTS,	100	WM. H. WILEY,	100
JOHN BOGART,	100	H. G. MORSE,	50
MENDES COHEN,	100	STANCLIFF B. DOWNES	50
JAMES ARCHBALD,	100	JOHN THOMSON,	50
JOS. P. DAVIS,	100	W. W. CARD,	50
FRED GRAFF,	100	EDMUND HAYES,	100
SAM'L. HEA.	50	WASHINGTON JONES,	100
F. COLLINGWOOD,	100	A. B. PAINE,	50
J. R. RICHARDS,	25	D. MCN. STAUFFER,	50
G. S. GREENE, JR.	50	A. M. WELLINGTON,	50
J. F. FLAGG,	100	GEO. H. FROST,	50
J. W. ADAMS,	50	OBERLIN SMITH,	25
T. GUILFORD SMITH,	100	E. W. ECKERT,	100

SUMMARY.

One of $1,000	$1,000
Two of 500	1,000
Two of 200	400
Fifteen of 100	1,500
Fifteen of 50	750
Three of 25	75
Total, 38 subscriptions, amounting to	$3,725

PERSONAL.

W. A. PRATT has been appointed Engineer of Maintenance of Way on the Philadelphia Division and branches, of the Baltimore & Ohio R. R.

GEORGE S. RICE, a Civil Engineer, of Boston, Mass., was appointed Deputy Chief Engineer of the New Croton Aqueduct, by the Commission, on July 6, at a salary of $7,000 per annum. Mr. RICE is a graduate of Harvard, and has had an extended engineering experience in the construction of the Sudbury Water supply and the Improved Sewerage works of Boston, among other works. He has been practicing as a mining engineer since 1861.

Chief Engineer HENRY L. SNYDER, U. S. N., Superintendent of the State, War & Navy Department building at Washington, D. C., died in that city June 30.

CLARKE—CASE.—In Syracuse, N. Y., Thursday, June 30, 1887, by the Rev. E. G. THURBER, Mrs. MARY M. CASE, of Cazenovia, to Major H. WADSWORTH CLARKE, of Syracuse.

H. G. CLARK has been appointed General Superintendent of the Missouri Pacific R. R., with headquarters at Sedalia, Mo. He succeeds FRANK B. DRAKE, who has resigned to accept the position of General Manager of the Cincinnati, Jackson & Mackinaw R. R., with headquarters at Van Wert, O.

A. A. TALMAGE, Vice President and General Manager of the Wabash Western R. R., died at Peru, Ind., on June 28. CHAS. M. HAYS, Assistant General Manager, has been appointed General Manager, and will also have authority over the Detroit, Butler & St. Louis R. R., and the Eel River R. R.

CHRISTIAN E. DETMOLD, C. E., a native of Hanover, but for many years resident in this country, died in New York July 4, at the age of 77. Mr. DETMOLD was the promoter of the Crystal Palace established in this city in 1853, in imitation of the original in London in 1851. He acted as superintending architect and engineer, with HORATIO ALLEN, Consulting Engineer, and EDWARD HUBBY, Consulting Architect. The Crystal Palace was inaugurated July 14, 1853, but although popular for a time it was not a success. In 1854 its president, P. T. BARNUM, had a reinauguration held, which revived interest for a time. The Crystal Palace was totally destroyed by fire on October 6, 1858.

SOCIETY PROCEEDINGS.

Montana Association of Civil Engineers.—It is proposed to organize an association in the Territory, and a committee issued a circular in May, addressed to the engineers in Montana, asking their views. A number of replies were received, all in favor of such an organization and a preliminary meeting was arranged to be held July 5 at the office of the Surveyor General Helena, Mont. The committee consists of GEO. E. REEDER, JOHN W. WADE and J. S. KEBEL.

PUBLICATIONS RECEIVED.

YOUNG & SONS, the well-known makers of Engineering and Surveying Instruments, of Philadelphia, Pa., have just issued a new and very complete price-list of their manufactures. They illustrate and describe a number of their latest attachments and improvements on transits and levels. They note that they are now prepared to make instruments of aluminum, but do not endorse this metal for the *whole* instrument. As made the additional cost is about 50 per cent. with a saving of over one-half in weight, not including tripod. Among the endorsements of Mr. YOUNG'S transits is one from WM. F. SHUNK C. E., which is so characteristic that we quote it. After stating that his Young Transit, Level and Rod were in their 18th year of service and are in excellent order, Mr. SHUNK mentions that they "have gotten repairs no oftener than an Eskimo gets a bath, an accidental capsize being the cause in both cases and good health the normal state meanwhile." This price-list is very complete covering every demand of the engineer and surveyor in the way of instruments and is a good thing to keep handy.

The Heating Power of Coal.

The *Bulletin de la Société Industrielle du Nord* gives the following notes upon the heating properties of coal:—The calorific power of a combustible is the number of heat units that one kilogramme of this material will produce by its complete combustion. In figuring out the comparative values of the various combustibles and heat generators the notation used by the author, M. CORNUT, is—C = carbon; F = fixed carbon; O = oxygen; H = hydrogen and C^v = volatile carbon.

M. DULONG has proposed for the determination of the value of the heat unit, Q, the following formula:

$$Q = 8.080\ C + 34.462\left(H - \frac{O}{8}\right)$$

But this formula always gives results too light by from 15 to 20 per cent., and the difference between the heating power observed and those thus calculated vary according to the coal formation and the quality of coal in the same formation.

M. SCHEURER-KESTNER in his treatise uses this formula,—$Q = 8.080\ C + 34.462\ H$, in which the results are more satisfactory, but the units calculated are still lower than those observed.

M. CORNUT admits that the combus ible elements, fixed and volatile carbon and hydrogen, are in the coal in a combined state, and he proposes to calculate the caloric power of this ternary compound by the formula—$Q = 8.800\ F + 11.214\ C^v + 34.462\ H$, which gives much more exact results than the preceding formulæ.

TECHNICAL NOTES.

A NEW map of Baltimore harbor has been completed under the direction of Maj. N. H. HUTTON engineer of the harbor board. It is on a scale of 150 ft. to the inch, and measures 110 x 50 in. It is said to be finely executed, and very full and exact in its topographical and hydrographical information.

THE *Electrical Review* says the largest electric light in the world, is in the Sydney, Australia, lighthouse. It has a power of 180,000 candles, and may be seen from ships fifty miles out at sea. The next largest is in the Palais d'Industrie, and has a power of 150,000 candles. The largest light in America is 24,000 candle power. It is at San Jose, Cal.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

CONTINUED FROM PAGE 13.

Danielsonville, Conn.—The works were commenced July 29, 1886, and are not yet completed; the reservoir is built, the principal streets are piped and about 70 taps have been made. The first water was delivered Dec. 23, 2886. F. C. KIMBALL was Constructing Engineer. L. G. Wright was the contractor for masonry, foundations and reservoir, and Ferris & Halliday were the contractors for trenching and pipe laying. The franchise is owned by the Crystal Water Co.; President, T. E. HOPKINS; Secretary, M. P. DOWE. No contract has yet been made with the town.

Selma, Ala.—The works were commenced March 15, 1886, and were accepted June 23; they were designed by Capt. W. H. WHITE, New York, and Col. C. A. WHITE, of St. Paul, Minn., acted as Constructing Engineer. The contractors were; for masonry and foundations, A. J. Mullen, Selma; for buildings, R. Stephens, Selma; for pumping machinery, H. R. Worthington, New York; for pipe and specials, Chattanooga Foundry & Pipe Co.; for valves and hydrants, Ludlow Valve Co., Troy, N. Y.; for stand-pipe, Tippett & Woods, N. Y.; for trenching, pipe laying and reservoir, C. A. White, St. Paul, Minn. The trenching and pipe laying was paid for by day labor. The stand-pipe is 120 ft. high. The franchise is owned by the Selma Water Co.; President, WM. H. WHITE; Secretary, S. W. JOHNS; Superintendent, THOS. K. GATCHELL. The franchise is for 10 years and the hydrant rental is $55 per annum. The present population is estimated at 12,000.

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

(TO BE CONTINUED.)

CONSTRUCTION NEWS.

Water.

The New Jersey Superheated Water Co. has been incorporated at Newark, N. J., by JOHN D. HARRISON and others, with a capital stock of $5,0 0, to supply heat and power through pipes in the streets to manufacturers.

Ditch Companies.—The Osage City Water Co. has been incorporated in New York by Geo. B. Inman and others, to supply water for irrigation purposes in Osage City, Kan.——The Manhattan Ditch Co. has been organized at Manhattan, Col., to bring water from the Elkhorn creek through Manhattan for mill and ore reduction purposes.

Syracuse, N. Y.—The Common Council has granted a franchise to the Salmon River & Onondaga Water Co.

Gainesville, Tex.—JOHN J. O'DALY has been engaged in constructing works to furnish the city with a water supply. A subterranean river was struck by prospecting, and by means of a puddle wall from bluff to bluff, 3,700 ft., and two extra dams in the creek, it is expected to hold an aggregate supply from all sources of about 160,000,000 galls. H. B. FLETCHER is President of the water company.

Annual Report of the Montreal Harbor Commissioners.—The Harbor Commissioners, Montreal, Canada, have issued their report for the year 1886. The report of JOHN KENNEDY, M.Inst. C. E., Chief Engineer, states that the principal work of the year consisted in dredging basins, deepening the ship channel through the harbor, and in raising, repairing, rebuilding and widening wharves; the work done and the cost are given in detail. The dredging fleet consists of four spoon (or dipper) dredges, two derricks, two screw tugs, with scows and floating shop; the price per cu. yd. is given for the last 11 years. During the year 57,728 cu. yds. were dredged, at a total cost of $25,772; averaging 44 cts. per cu. yd.; the highest price was 74½ cts. per cu. yd., for hard pan, gravel and boulders, in 26 to 30 ft. of water; the lowest was 42½ cts. per cu. yd., for shale, hard pan and gravel, and clearing boulders with stone lifting barge. The ship channel between Montreal and Quebec is being deepened from 25 ft to 27½ ft. at low water, with a minimum breadth of 300 ft., and on this work 1,523,588 cu yds. have been dredged, the 2½ ft. being, as a rule, taken out in one cut; the prices ranged from 10.37 cts. per cu. yd. for elevator dredges, to 42.68 cts. for spoon dredges. This work is also described in detail. The report contains data and tables of the shipping tonnage, the receipts and expenditure, weather, etc., and information and correspondence respecting the flood protection and other matters. ANDREW ROBERTSON is Chairman of the Commissioners and H. D. WHITNEY, Secretary. JOHN KENNEDY is Chief Engineer, and THOMAS HOWARD is Harbor Master.

Troy, N. Y.—The Water Commissioners have submitted their report for the year ending March 1, 1887, the 32nd annual report, to the Common Council. The works are reported in good condition and the supply ample; the matter of charges for water motors has been reported upon by the Chief Engineer and is under advisement. During the year 9,596 ft. of 4, 6 and 8-in. pipe were laid. The system now consists of 274,812 ft. of 1½, 3, 4, 6, 8, 10, 12, 16, 20 and 24-in. cast-iron pipe and a 30-in. cast-iron force main; there are 578 fire plugs and 859 stop valves, exclusive of those in private service. The works are owned by the city. The water is taken from 5 artificial storage reservoirs in the valley of the Piscawenkill, and from the Hudson river; the supply is by gravity, the river water being pumped to an elevation of 231 ft. There are 2 sets of Holly quadruplex engines with a capacity of 6,000,000 galls. The total pumpage for the year was 1,889 414,858 galls. The population is estimated at 60,000, with 51,368 on the line of pipe and 45,700 supplied. The total consumption was 300,000,000. The service pipes are of lead and cast iron, ¾-in. to 6-ins. diameter; there are 5,012 ft. with 262 taps. There are 43 meters and 95 motors and elevators. The report contains numerous tables and diagrams of the engine performance, rainfall, etc., and a table showing the water-works of 30 cities in comparison. PALMER H. BAERMANN, C. E., is Chief Engineer, and EDWARD H. CHAPIN, Superintendent.

Albany, N. Y.—It is reported that the new water commission has awarded the contract to Andrews Brothers, New York, for a water supply from the Van Rensselaer flats of 10,000 000 galls. per day; the contract price is $237,500. The quality test will be for 3 months and the quantity test for 6 months; at the end of this time, if the contractors have failed to pump 10,000,000 galls. per day, the commission may reject the plant or accept it for a reduced price in accordance with the supply furnished. In the proposed new system, the water from the flats will be pumped direct through a conduit of 15,000,000 or 25,000,000 galls. capacity to the Bleecker reservoir, and connections are to be made with the new Tivoli lake reservoir, so that it can be supplied from the wells on the flats in case of necessity. The new Tivoli lake reservoir will have a capacity of 15,000,000 galls., and will be supplied by means of reservoir dams in Sand creek and Patroons creek. Engineer DE VARONA'S preliminary report recommends that the new pumping station should be built with a view to ultimately accommodate a plant of 25,000,000 or 30,000,000 galls. capacity; and that pumping power sufficient for present consumption should be provided at once, with a reserve in case of emergency. He suggests provision for three sets of double engines with a daily capacity of 10,000,000 galls. each; the engines to be of the vertical, compound, beam type, and each double engine to consist of two single engines of 5 000,000 galls. capacity each, capable of being run separately. He recommends that the force mains to Bleecker reservoir, Tivoli lake and Prospect hill, should be 42 or 48 ins. in diameter.

San Francisco, Cal.—The Spring Valley Water Co is at work on the construction of the large dam across the outlet of the Calaveras valley, for the purpose of utilizing the valley as a great supply reservoir. The

valley is 6 miles long and 1¼ miles wide. The water of the Calaveras and Alameda creeks will supply the reservoir, the former supplying 5,000,000 galls. and the latter 3,000,000 galls. per day. The bottom of the basin is 130 ft. above the summit of Telegraph hill, in the city. To take the water to San Francisco two plans are proposed, one to conduct it to the company's lakes in San Mateo county, and the other to lay pipes across the marshes south of Milpitas.

Water Companies.—The New Hampshire Legislature has passed an act to incorporate the Tilton and Northfield Aqueduct Co.

The Artesian Water Co., Memphis, Tenn., has had $100,000 subscribed of the $1,000,000 capital, and work will be commenced at once. R. C. GRAVES is President.

The City Water Co. has been incorporated at Merrill, Wis., by ELISHA L. BUMP and others, with a capital stock of $100,000.

The Santa Barbara Water, Land & Cinnabar Co. has been incorporated at San Francisco, Cal., by D. H. JONES, S. W. MILLER, E. J. RYAN, S. P. PLATT and H. M. GIBSON. Capital stock, $4,600,000.

The Phœnix City Water Works Co., Phœnix, Cal., has been incorporated by MORRIS ft. LOCK, C. S. MATEN and M. H. SHERMAN. Capital stock, $100,000. The works are to be in operation by the end of December.

The Riverside Water Co., Riverside, Cal., has elected Dr. J. J. JARVIS, President, and W. P. RUSSELL, Vice President.

Stone Dam.—The manufacturers of Little Falls, N Y., have decided to build a new stone dam across the Mohawk river to replace the one destroyed by high water. It will be 338 ft. long and 12 ft. high, and will cost over $12,000. STEPHEN E. BABCOCK, of Little Falls, is the Engineer.

Minneapolis, Minn. At a recent meeting of the Board of Health Dr. KILVINGTON criticised the city's water supply. He stated that the sanitary condition of most of the wells in the city was bad and that there were constant complaints of contamination by the proximity of cesspools and vaults. He said "there are in Minneapolis over 50,000 cesspools and vaults. The latter all discharge their contents into this sandy soil on which the city is built, and sooner or later they will get the best of us. We ought to do something about it, and I believe the only way to deal with the evil successfully is to pass an ordinance prohibiting the employment of cesspools, and compelling every property owner to connect his buildings with the sewers." The three physicians of the board were appointed a committee to investigate and report on the water supply.

New Water-Works.—Farmington, Me. The waterworks project has been postponed indefinitely.—Windsor, Vt. The village corporation is contemplating an additional water supply and surveys for this purpose have been made recently by GEO. H. LELAND, of Providence, R. I. HUGH GILCHRIST is Chairman of the Committee.—Hillsborough, N. H. Water-works have been authorized by the legislature.—Providence, R. I. The Board of Public Works will have plans and specifications prepared for a high service reservoir on Fruit Hill; $50,000 will be raised for its construction.—Warsaw, N. Y. Col. J. O. MCCLURE is making the surveys for the additional water supply.—Newark, N. Y. Moffett, Hodgkins & Clarke, of Watertown, N. Y., will soon commence work.—Saugerties, N. Y. The water company has laid its pipes.—Mechanicstown, Md. The water company will build its own works.—Cincinnati, O. The water supply has been shut off from Clifton, O., as the consumption was so great as to render the supply to Corryville inadequate.—Florence, Ala. The American Water-Works & Guarantee Co., of Pittsburg, Pa., has made a proposition to build waterworks here and at Tuskaloosa, Ala.—Americus, Ga. The works will be built by Ellis & Slocum, of Montgomery, Ala.—South Pittsburg, Tenn. City Engineer CLUTE is preparing plans for a reservoir with a capacity of 350,000 galls.; a pumping station will probably be established.—Savannah, Ga. Work is progressing on the artesian wells; No. 10 is flowing 600 galls. per minute; the supply will ultimately be entirely artesian water.—Griffin, Ga. Water-works will be built.—Waco, Tex. The contract with Inman Bros., of New York, has been ratified.—St. Cloud Minn. The city proposes to sell the works.—Duluth Minn. New mains are being laid, and a new Worthington pump will be put in.—Eaton Rapids, Mich. The Michigan Central R. R. Co. is putting in waterworks.—Detroit, Mich. Iron is to be substituted for the present wooden pipe.—Glenwood Springs, Col. The De Lano proposition has been voted down by a majority of 3; works will be established, however.—Butte, Mont. The Silver Bow Water Co. will build works at a cost of $50,000.—Oakland, Cal. The Contra Costa Water Co. will build two new reservoirs.—San Francisco, Cal. The Spring Valley Water Co. is preparing to furnish a large additional supply, and wants the city to shut off the company's water from the City Hall elevator and operate it from the artesian well.—Santa Ana, Cal. A syndicate has been organized to furnish a water supply.—Kingston, Canada. The price of the works which the city wants to acquire has been set at $120,000 by arbitration, which gives general satisfaction.

The Burlington Steam Supply Co., Burlington, Ia., has the following officers: President, THEODORE GUELICH; Vice-President, J. W. GILBERT; Treasurer, T. W. BARHYDT; Secretary, J. F. HENRY; Superintendent, J. J. SPATCH.

Proposals Open.

Water-Works.—H. S. SALISBURY, City Clerk, Whitewater, Wis.

Railroad.—Extension from Burnet, Tex., to Marble Falls. THE SECRETARY, Austin & Northwestern R. R. Co., Austin, Tex.

Bridges.—Six iron Pratt truss bridges; 35 to 60 ft. span; plans, specifications and strain sheets on file. JULIUS RAPP, Commissioner of Roads and Bridges, Clayton, Mo. July 11.

Railroad.—Grading and pile trestling for single track line between Manumuskin, N. J., and Port Norris, on the Delaware river, 10 miles. WM. H. BROWN, Chief Engineer, Maurice River R. R. Co., 233 S. 4th street, Philadelphia, Pa. July 11.

Water Works.—Plans, specifications and proposals; 3 to 5 miles of mains, 35 to 50 hydrants. A. W. WARDEN, Town Clerk, Washburn, Wis. July 12.

Stocks.—Additional water stock, $1,000,000; consolidated stock, $500,000; dock bonds, $500,000. EDWARD V. LOEW, City Comptroller, Stewart Building, New York City. July 13.

Sewer.—Brick sewer, 2,300 ft., 40½ x 52½ ins. JOSEPH J. KELLY, Chairman of Sewer Committee, Cambridge, Mass. July 14.

Dredging.—At piers 12, 13, 14, East river; 7,500 cu. yds., 14,500 cu. yds., 3,000 cu. yds. THE DOCKS COMMISSIONERS, Pier A, North River, New York City. July 18.

Breakwater and Stone.—Breakwater at Gordon's Landing, Lake Champlain, Vt., 500 lin. ft.; rubble stone, 7,160 cu. yds; large stone (1 to 3 tons), 3,957 cu. yds. MAJOR M. B. ADAMS, U. S. Engineer Office, Burlington, Vt. July 19.

Dredging.—Improving Raritan bay, N. J. Lieut. Col. WALTER MCFARLAND, U. S. Engineer Office, Army Building, corner Greene and Houston streets, New York City. July 20.

Dredging.—In the ship channel, Galveston bay, 900,000 cu. yds. of soft material. Major O. H. ERNST, U. S. Engineer Office, Galveston, Texas. July 20.

Pile Dike.—At Saugerties harbor, N. Y. Lieut Col. WALTER MCFARLAND, U. S. Engineer Office, Army Building, corner Greene and Houston streets, New York. July 20.

Sewers and Wood Paving.—Sewer: 4,700 sq. yds. white pine block paving. WALTER P. RICE, City Engineer, Cleveland, O. July 21.

Bridge.—Masonry and iron superstructure. FRED RAINE, County Auditor, Cincinnati, O. July 23.

Sewer.—Brick sewer, 36 x 54 ins., 540 ft.; 4,100 ft. of pipe sewer from 9 to 18 ins.; 18 manholes, 7 catch basins; 4,000 lin. ft. of house connections. WILLIAM DAVIS, City Recorder, Mankato, Minn. July 26.

Bridge.—Abutments, piers and iron superstructure; also, bridge repairs at North Manchester. WM. HAZEN, Auditor, Wabash, Ind. August 1.

Poles and Brush.—Willow poles, 2,000 cords; willow brush, 8,000 cords. Capt. SMITH S. LEACH, U. S. Engineer Office, Memphis, Tenn. August 1.

Bridge.—Iron or wood, over Hammer creek; specifications on file for wooden bridge. THE COUNTY COMMISSIONERS, Lancaster, Pa. August 1.

Water Works.—Plans and specifications or file. F. D. WILLIAMS, City Clerk, Crete, Neb. August 2.

Contracting.

Lake Shore Protection.—Proposals opened recently at Racine, Wis., for piling for shore protection ranged from $14 to $19 per ft.

Water Pipe.—The contract for 150 tons of 12-in. pipe has been awarded by the Water Board, Lowell, Mass., to the Gloucester Iron Works, Philadelphia, Pa., at $35 per ton of 2,240 pounds.

Water-Works.—The contract for the works at Yorkville, Ill., has been awarded to G. C. Morgan, of Chicago, at $6,800.29; they are to be completed by November. P. FRAM is President of the Water Board.

Bridge Contracts.—The Bullen Bridge Co., Leavenworth, Kan., has the contract for a 36 ft. and a 30 ft. iron bridge at Pueblo, Col. The plans were prepared by H. C. LOWRIE, C. E., of Denver.

The Detroit Bridge & Iron Works Co., was the lowest bidder for the Jackson street bridge, Chicago, at $76,500.

Red River Valley Ry.—The contract for the construction and equipment of this road in Manitoba from Winnipeg to West Lynn, opposite Pembina, Dak., 75 miles, has been awarded by the Manitoba Government to Hugh Ryan, of Toronto, for $762,480.

Road Improvement.—Proposals for the improvement of Bennings road were opened recently by WM. LUDLOW, Engineer Commissioner, Washington, D. C. The prices ranged as follows: grading, 24¾ to 48 cts.; macadam, 30 to 98 cts.; macadam with Telford base, 20 cts. to $1.75; gravelling, 19 to 30 cts.; cobble gutters, 25 to 65 cts.; rubble masonry, $3.50 to $7.

Sewers.—The following were the lowest bids received recently at the Bureau of Surveys, Philadelphia, Pa.: Main sewers; W. H. H. Achuff, $33.95 per lin. ft.: John S. Dutton, $10, $26 and $28; Peter Deehan, $17.60 and $59.75. On branch sewers the bids had an average range from $1.95 to $4.25. The bidders were W. B. M. Conklin, John McParland and H. C. Eyre.

Beacon.—The following proposals for an iron beacon at Milwaukee, Wis., were opened June 30 by Maj. S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich.: Russell Wheel & Foundry Co., Detroit, Mich., $6,532. West Point Foundry Association, Cold Springs, N. Y., $8,700; John Cooper, Mt. Vernon, O., $9,865; J. G. Wagner, Milwaukee, Wis., $14,800.

Belle Isle Bridge.—The following proposals have been received by the Board of Public Works, Detroit, Mich.: Detroit Bridge & Iron Works, $280,000; Mount Vernon Bridge Co., Mount Vernon, O., $281,000; Milwaukee Bridge & Iron Co., Milwaukee, Wis., $287,000; King Iron Bridge & Manufacturing Co., Cleveland, O. $350,000.

Steel Forgings.—The Midvale Steel Co., Philadelphia, has made a proposal to furnish 10 sets of steel forgings for 6-in. B. L. rifles and one set of chase hoops for a 10-in. gun, aggregating about 65 tons, for the Navy Department. The price is $59,969 if rough bored and turned, or $53,385 if this work is done at the Washington Navy Yard.

Dredging.—The following proposals for dredging in the Virginia channel of the Potomac river at Washington, D. C., were opened June 30 by Lieut. Col. PETER C. HAINS, U. S. Engineer Office, Washington: John H. McNee, Washington, 15 cts., per cu. yd., $45,000: Ross & Sanford, Jersey City, N. J., 19 cts., $57,000: Morris & Cummings Dredging Co., New York, 19 cts., $57,000.

The only proposal for removing the rock bar, 30,000 cu. yds., in the Ohio river at the mouth of the Licking river received July 5 by Lieut. Col. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O., was from I. V. Hoag, Jr., of Pittsburg, Pa., 13 cts. per cu. yd. The amount available is $18,000.

Drainage Works.—The following proposals for the Forbes drainage works at Tilbury East, Ont., have been received by D. R. FARQUHARSON, of Fletcher, Ont.: Thos. Elliott, Brantford, Ont., $50,110; A. McDonald & Archibald Young, Toronto, $49,998.50; Chatham Dredging & General Contracting Co., Chatham, Ont., $45,500; Walter Welsh, Tilbury West township, Ont., $44,750. The last named is understood to represent a Detroit dredging firm and will probably be awarded the contract.

Sewers.—The contracts for the Negley Run and 33rd street sewers, Pittsburg, Pa., have been awarded to Booth & Flinn, of that city, for $349,374 and $293,559. The total bid was $320,000 over the engineers' estimate of $323,000; ($185,000 and $138,000 respectively).

The following proposals were opened July 5 by P. C. HILLIARD, Chairman of Street Committee, Board of Public Works, Jersey City, N. J.: Thomas Coogan, $6,450.10; P. O'Neill, $6,601.25; Samuel Overton, $7,313.45; Thos. Cavanagh, $7,535; R. J. Waters, $9,171.05.

City Work.—The following contracts have been awarded at Hyde Park, Ill.: S. Halliman, sewer, $2.25 per ft.; M. Joyce, drains, 29 cts. per ft.; J. Hallaren, water service, 47 cts. per ft.; Dolese and Shephard, street improvement, $5,031 and $3,350; M. Joyce, drains, 22 cts. and 47 cts. per ft.; J. Murphy, drains, 45 cts. per ft.; O'Donnel & Mahoney, sewers, 12, 15, 24, 27 and 30-in., $2.39, $2.20, $2.62, $3.49, and $3.69 per ft. A. V. POWELL, is Superintendent of Public Works.

Beach Protection.—R. Kanters & Sons, of Holland, Mich., have submitted plans and specifications for the protection of the beach at the Concourse, Coney Island, on their Dutch fascine mattress system, to the Park Commissioners, Brooklyn, N. Y. They have made a proposition to build 500 ft. of shore protection, according to the plans submitted, and also 3 sand spurs or groins aggregating 375 ft. in length, to be placed as directed by the engineer in charge, for $6,500; the contractors assuming all responsibility for security against wave action for one year after completion.

Canal Work.—The following contracts for lengthening locks on the Erie canal have been awarded by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. Nos. 32 and 33, Soule & Raynor, $23,291.50, $26,360. No. 31, Clinton Beckwith, $21,079. No. 48, Faas & Ford, $15,117.50. No. 62, B. P. Smith, $26,509.20. No. 44, Daniel Ford, $28,134. Nos. 45, 53, 55, 56, John Moore, $28,403.75, $22,218.50, $34,986, $28,502. Nos. 57, 60, 61, Hughes Bros., $25,709.50, $25,895.50, $26,175. Proposals will be advertised for three other locks on the Erie and two on the Champlain canal.

Levee.—The following proposals have been received by the Board of State Engineers, New Orleans, La., for the Manade-Frechon-Antonia levee: Ogden & Jones 23.23 cts. per cu. yd.; P. Harnan, 28 cts. Contract awarded to Ogden & Jones.

Sewer Work.—At Providence, R. I., the following contracts have been awarded: Roscoe A. Woodbury, Pawtucket, R. I.; 12-in. pipe sewer, $1.18 per lin. ft.; 6-in. connections, 5 cts. each; manholes, $18 each. Roscoe A. Woodbury, 12-in. pipe sewer, $1.22 per lin. ft.; 8-in. pipe basin connections, 71 cts. per lin. ft.; 6-in. connections, 7 cts. each; manholes, $18 each. Franklin A. Snow, Providence, R. I., 18 and 20-in. single course brick sewer, $1.60 and $1.80 per lin. ft.; 12 and 15-in. pipe sewer, $1.08 and $1.10 per lin. ft.; 8 in. pipe basin connections, 80 cts. per lin. ft.; 6 and 8-in. connections, 10 and 15 cts. each; catch basins, $18 each; manholes, $19 each; extra inlets, $14 each.

Railroad Contracts.—Scott & Lyle, New Albany, Ind., have the contract for the entire construction of the Huntingburg, Tell City & Cannelton R. R., from Lincoln station, on the Air Line, to Cannelton. The work is to be finished by January, 1888. MORRIS MCDONALD is president of the railroad company, and D. W. SOLLIDAY, Secretary; both of New Albany.

John Kelso has the contract for the construction of the Cloverdale & Ukiah R. R., in California.

Condon Bros., of Nashville, Tenn., have the contract for grading the branch of the Kansas City, Memphis & Birmingham R. R. to Aberdeen, Miss., 10½ miles. Armstrong & Co., of Birmingham, Ala., have the contract for ties.

Jas. Graham, New York, has the contract for the Wilmington Street Railroad, Wilmington, N. C.

Harrison & Green have the contract for building 10 miles of road from Republic, Wis., to the Champion mine for the Milwaukee & Northern R. R. Co. The contract has been sublet to McIntosh Bros.

Dry Docks and Caisson.—The following proposals for timber dry docks, complete with caissons, pumps, etc., at New York and Norfolk, Va., was opened June 29 by D. B. HARMONY, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C.: J. E. Simpson & Co., 35 Broadway, New York, for both docks, $1,060,600; O'Connell & Coffey, Brooklyn, N. Y., for New York dry dock, $525,000.——The only proposal for an iron caisson or floating gate at the Boston navy yard, was from the Atlantic Works, East Boston, Mass., $33,500. The appropriation for the dry docks is $1,100,000, and for the caisson, $31,000. No awards have yet been made.

Granite Paving Blocks.—The following proposals were received June 30 by J. W. MCDONALD, Superintendents of Streets, Boston, Mass.: S. & R. J. Lombard; 50,000 small blocks, $42 and $44 per 1,000; 100,000 small blocks, $41.50; 100,000 Rockport small blocks, $47. McDonnell & Sons, small blocks $43. Cape Ann Granite Co., large, $68.95; small, $46.44. Rockport Granite Co., large $76.80; small, $53.90. Pigeon Hill Granite Co. large, 100,000, $79 per 1,000; small, 200,000, $58.

The following proposals for 60,000 granite blocks have been received by W. E. SYMS, Chairman of Committee on Highways, Holyoke, Mass.: Bidwell & Cooper, Chester, Mass., $1.55 per sq. yd. laid; S. A. White, Turners Falls, Mass., $1.65; Webb & Batchelder, Worcester, Mass., $1.95. Contract awarded to Bidwell & Cooper.

City Work.—The following contracts were awarded July 6 by the Commissioner of Public Works, New York City. Stop-cocks, hydrants, wooden hydrant boxes and cast-iron stop-cock boxes: G. C. Hotchkiss, Field & Co., $5,452.50.——Laying water mains: F. Thileman, rock and earth excavation, 30 cts. per cu. yd.; filling, 15 cts. per cu. yd.; 6 and 12-in. pipe, 30 and 50 cts. per lin. ft.; 6 and 12-in stop-cock boxes, $8 and $10; hydrant, $10; pavements, 25 cts. per sq. yd.; curb and gutter, 5 cts. per lin. ft.; brickwork, $1 per cu. yd.; total, $10,377.—Sewer repairs in 9th St.; Geo. F. Doak, $5,587.90. —— In 6th Ave, R. A. Cunningham, brick sewer, $7 per lin. ft.; concrete, $5 per cu. yd.; filling, 10 cts. per cu. yd.; 6-in. pipe, 60 cts. per lin. ft.; brickwork, $14 per cu. yd.; blue stone blocks, $1; wrought-iron girders, $7.50; tie rods, 25 cts. per lin. ft.; total, $5,717.——In 9th Ave.; B. Mahon, $7,734.——In 1st Ave.; Joseph Moore; concrete, $10 per cu. yd.; brickwork, $40 per cu. yd.; manhole, $100; total, $6,550.——Regulating and granite block paving on 110th St.; Chas. Guidet, pavement, $2.53 per sq. yd.; bridge stone, 59 cts. per sq. ft.; total, $27,243.35.

RAILROADS.

East of Chicago.

Existing Roads.—*Carthage & Adirondack.*—The final location is in progress on the 20 mile extension of this road from Jayville to iron mines in St. Lawrence county. The line runs through thick forest and has considerable rock work. Maximum eastern grades are 84 ft. per mile; maximum western grades, 66 ft. per mile. The right of way is secured and the railroad company will begin work at once clearing right of way and grading. E. A. BOND is Chief Engineer, and C. B. BENSON, General Manager.

Chicago, Kalamazoo & Saginaw.—Grading and tracklaying are in progress on the first division, 31 miles in length, of this Michigan railroad The line is eventually to run from Kalamazoo to Saginaw *via* Hastings, Portland and St. Johns, about 150 miles; but no more contracts will be let until next season. The division between Kalamazoo and Hastings will be open for the traffic about Oct. 1. FRANK C. BALCH of Kalamazoo is Chief Engineer.

Toledo & South Haven.—It is proposed to extend this road from Hartford to South Haven on Lake Michigan.

Cincinnati, Jackson & Mackinaw.—The Michigan & Ohio line may be extended from Allegan west 20 miles to Lake Michigan.

Chateaugay.—This line, which now runs from Plattsburgh, N.Y., to Loon Lake in the northern Adirondack region, it is proposed to extend 20 miles south to the Lower Saranac lake. The main purpose of the extension is to accommodate lumber interests and summer tourists.

Pittsburg & Western.—It is stated that this company is to take up the long delayed project of W. A. Lynch for a railroad west from Akron, O., and will build 110 miles of new lines to Carey, *via* Medina, New London, Greenwich, Plymouth, New Washington and Sycamore. From Carey to Delphos the Cleveland & Western narrow gauge will be altered to standard; and from Delphos to Chicago the route will be over the direct line of the Fort Wayne. The completion of these plans would give the Pittsburg & Western a route from Pittsburg to Chicago 30 miles shorter than the Pennsylvania and 70 miles shorter than the Baltimore & Ohio. The latter company, however, is interested, and will use the new line for its through traffic. Col. RICHARD NEVINS of Pittsburg has just completed a survey for the new cut-off and estimates the cost of construction a $8,500 per mile. It is stated that the officers of the company have already provided for raising sufficient funds for construction, and propose to have the new trunk line in running order within a year.

Huntingburgh, Tell City & Cannelton.—SCOTT & LYLE have begun work on this Indiana line 21 miles in length, and are to complete it by Jan. 1 MORRIS MCDONALD of New Albany is President of the company and the Louisville, Evansville & St. Louis, with which the new road connects at Lincoln, is interested in the line.

Boston & Maine.—It is said that if this company is finally thwarted in its present determined effort to obtain control of New Hampshire railroads, it will build a line from Alton Bay to Lake Village along the shore of Lake Winnepiseogee. The charter for this was granted in 1881. The company has also under survey a line from Essex, Mass., to Rockport, on the Gloucester branch.

Hartford & Connecticut Western.—The extensions of this line to accord with the schemes of the Pennsylvania & New England Construction Co. will be pushed at once. The connection to Poughkeepsie is under contract and the surveyors are at work on the line from Tariffville, Conn., to Springfield, Mass.

Grand Rapids & Indiana.—The project for a branch from Grand Rapids via Lansing to Detroit, is said to be taking definite shape.

Lake Erie & Western.—An extension is proposed from Minster to Piqua, Ohio, to connect with the Cincinnati, Hamilton & Dayton and Pennsylvania systems.

Cornwall & Lebanon.—R. H. COLEMAN, President of this Pennsylvania road, proposes to extend it from Lebanon to Reading, a distance of 28 miles.

New Projects and Surveys.—*Canastota, Morrisville & Southern.* This line is to run from Canastota, N. Y., on the New York Central, West Shore, and Elmira, Cortland & Northern railroads, south via Peterboro, Morrisville and Eaton to connect with the Ulster & Delaware in Otsego county, a distance of 70 miles. This will give a line to New York City from Madison' Otsego and Delaware counties, 25 miles shorter than any existing. The preliminary surveys have determined a line of light work and grades and little bridging. About 20 miles of right of way is secured. WALTER F. RANDALL, Morrisville, N. Y., is Chief Engineer.

Baltimore & Eastern Shore.—Right of way is nearly secured for this Maryland road, which is to run from Annapolis to Salisbury, a distance of 54 miles, connecting with the Wicomico & Pocomoke, at the latter point. The Baltimore Merchants and Manufacturers' Association, of which J. R. BLAND is Secretary, will probably assist the projectors of the line in raising funds for the work.

Rome & Carthage.—This projected line is being surveyed through Oneida and Lewis counties in Northern New York, and will be about 56 miles in length. A company has not yet been organized. A. C. KESSINGER is secretary of the committee which is conducting the survey.

Mohawk & Susquehanna Valley.—This company has just been organized to construct a railroad from Canajoharie to Cooperstown and Richfield Springs, in Central New York. Among the directors are SIDNEY DILLON and ARTHUR W. SOPER, of New York, and W. J ARKELL of Canajoharie.

Chittenango.—A short line is projected at Chittenango, N. Y., running from the station to the village.

Clearfield & Dubois.—This is the title of a proposed independent line to run between the points named in Clearfield county, Pa. The line will develop valuable coal and timber interests,

Buffalo & South Park Belt Line.—Incorporated by HENRY W. BOX and others of Buffalo, to build a line, five miles in length, in the town of West Seneca, connecting the Pittsburg and Buffalo divisions of the Buffalo, New York & Philadelphia.

Alba, East Jordan & Frederic.—This Michigan road is to be 45 miles in length, extending from East Jordan to Frederic. For all but two miles of its length, the road runs through the large timber tract of 210,000 acres owned by DAVID WARD, of Pontiac, Mich. The tract bears some 1,400 million feet of marketable timber, mostly white pine of excellent quality. The proposed line has been surveyed and work has already begun on clearing the right of way and grading. The line will be standard gauge and substantially constructed, and the work is under the direction of the owner, no contracts being let. F. L. BARKER is Chief Engineer.

Fort Plain & Richfield Springs.—A company has been organized to build between these points in competition with the Mohawk & Susquehanna project mentioned above. WM. CLARK, of Fort Plain, is interested.

Indiana & Lake Michigan.—Incorporated in Indiana by A. S. DYCKMAN and others, to build a railroad from South Bend to Buchanan.

Southern

Existing Roads.—*Ohio Valley.*—An extension is under consideration crossing the Tennessee river at Clifton and passing through Pulaski.

Orange Belt.—On the southern extension of this Florida line, construction trains are running to Clermont. A branch is to be built to Lake Apopka.

Memphis & Charleston.—It is reported that this company has secured an option on the controlling interest in the Memphis & Little Rock road, this being a move toward an extension of the Richmond Terminal system west of the Mississippi.

Raleigh & Augusta Air Line.—The Palmetto line has reached the Pee Dee river opposite Cheraw, S. C. The line will probably be extended to Camden.

Kingwood & Tunnelton.—This West Virginia road has been completed ready for tracklaying; but it is reported that a hitch in financial matters may delay the completion indefinitely.

Louisville & Nashville.—Work on the new lines is being delayed by the scarcity of laborers. The Bardstown—Springfield road will not be finished before Nov. 1. On the Pineville extension the 1100 ft. tunnel will delay completion until late in the Fall.

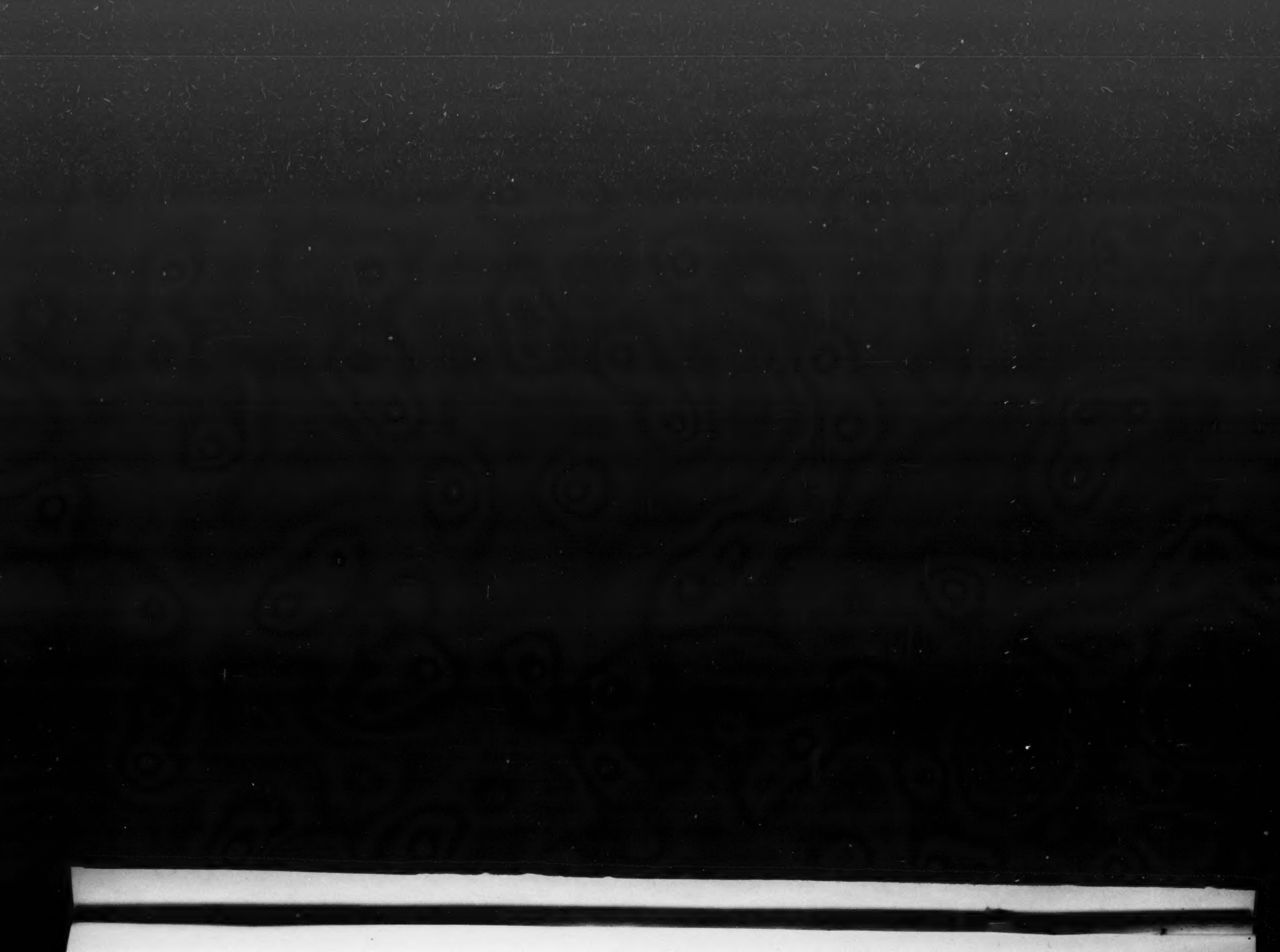
Marietta & North Georgia.—It is said that this company has raised sufficient funds to build the contemplated extension from its present terminus at the Georgia State line to Knoxville, Tenn. As soon as possible the whole line will be altered to standard gauge.

Clarkeville, Blue Wing & Durham.—Work is in progress on this line running from Durham, N. C., northeast, *via* Oxford, Blue Wing and Clarkeville, to Richmond, Va.

New Projects and Surveys.—*Durham & Lynchburg.* The final location is in progress on this line, which is to run from Lynchburg, Va., to Durham, N. C., via Rustburg, South Boston and Roxboro, 106 miles. Contracts for construction will be let by Aug. 1. It is also proposed to extend the line from Durham south to Fayetteville, 76 miles. PETER J. OTEY, of Lynchburg is President, and J. W. GOODWIN, Chief Engineer.

Durham & Northern.—This company, which was chartered last winter, proposes a line from Durham east to Williamstown at the mouth of the Roanoke river, about 100 miles. The eastern end of the line has been built and is in operation, from Williamstown to a point 5 miles west of Nashville as a branch of the Wilmington & Weldon. The original charter was in the interest of the Raleigh & Gaston, and as the former company does not propose to build the line farther west at present, it is probable that the latter company or interested parties in Durham may take up the project.

Wilmington Sea Coast.—This projected line, running from Wilmington, N. C. to Wrightsville and the ocean beach, 10 miles, has been surveyed, and right of way is secured, and the projectors are raising funds to begin work. IREDELL MEAR, of Wilmington, is Vice-President.

Wilmington, Onslow & East Carolina.—This company has asked a subscription of Wilmington. EUGENE MARTIN is Secretary.

Louisville, Cincinnati & Virginia.—This company, whose organization was reported last week, has submitted a request for a subscription to Lee and Estill counties in Kentucky. The line from Winchester to